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2/11/11	Memorandum Report to Skagit County BOC fm J.M. Clapp, Consulting Engineer re his mapping and report of the Skagit River in accordance with the BOC "order" dated 12/19/10.	This 39 paragraph report and attached maps delineated the banks of the river as they were in 1897 and in 1907. The maps were not reviewed in the JES files but the County must have them in their archives. Some of the more interesting comments were: ¶2. Skagit navigable throughout the whole year as far as Avon, 16 miles from the mouth. During freshet seasons, as far as "the portage", a distance of about 95 miles from the mouth. ¶4. The source of the Sauk is free from snow for a few weeks in the year only, while the Baker and its tributaries have their sources in the constantly snow-clad sides of Mt. Baker and Shuksan. ¶5. Recognized floods can happen any month of the year. Stated that dikes during high floods "are undermined and tumble into the river resulting in a great sea of water, rushing like a torrent across the low lying fertile farmers, between the river and the salt water, and which for weeks at a time remain inundated. ¶6. Estimated flood flows to be 100,000 to 120,000 cfs. ¶7. Fall of river btwn Baker and Woolley 2.5 ft to the mile. Woolley to Mt. Vernon about 1.5 ft to the mile. Mt. Vernon to mouth 1 ft per mile. . ¶8. Talking about the dikes "In some places they are unnecessarily high, in others dangerously low, and in a good many places, they are weak and thin, and for a long stretches they are too near the river banks. The placing of dikes to near the river banks confines the waters so much that at times of freshets and floods an abnormal rise is produced, and also exposes the dike to the swift current, which at times washes it away. ¶9. Recommended to BOC that a single dike district be formed ran by a "competent, experienced Civil Engineer". ¶12. "The cost of this should be borne in part by the	Amazing. The Board of County Commissioners hires a private consultant who tells them in 1911 that they have to move the levees off the edge of the river. The consultant clearly utilized the 1897 Corps of Engineers report to write his report. **NOTE**: No mention of Glacier Peak. **NOTE**: Almost this exact same quote was used by the Corp of Engineers in their 1897 report which is probably where he got it from.

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		State and the money so expended by the state will be repaid many times in regular taxation. ¶15. The County should bear the cost of location, construction and maintaining them (dikes). ¶20. Recommended 90,000 feet of riverbank between Woolley and mouth be turned into a "revetment" by using a "uniform grade of not greater than 1ft vertical to 2 ft hor covering. This graded bank with a compact layer of willow & brush fascines woven together with wire and well staked to the bank. This carpet of brush fascines should be securely weighted with stones …" ¶21. Cost "about" 4 dollars per foot or $360,000. ¶25. Suggested road and RR between Burlington and Sedro Woolley be raised "well above previous flood heights". ¶'s 27 to 29. Suggested raising dikes with a cross section of 20 ft. on top with "side slopes one on two on the river side and one on one on the land side." ¶33. Estimated cost for levee improvements $100,000. ¶Referred to Fir Island as "Skagit Island" and recommended straightening of North Fork.	
5/2/18	Transcription of JES[1] "flood" notes on 5/2/18 by USGS 6/30/23 re Reflector Bar near Marblemount	JES was using a hand-held "Seattle levelman's level". He measured the December 29, 1917 high-water mark at "6.15 feet above present water surface." 1909 high-water "8.6 feet above present water surface. He stated, "…it can be assumed that the 1909 flood was 2.5 feet higher than 1917." "Estimated fall in water surface .3 per 100 feet or 1.8 feet." "People who have lived in the Skagit Valley since 1888 say floods of 1897, 1909, 1917 are the only big ones of which 1909 was the largest above Marblemount." In talking about a larger flood event he states, "I think the only flaw in the flood flow of this great flood is the possibility of a log jam or snow slide in the	Reflector Bar is 47 miles above Concrete which according to the Bodhaine/Stewart 1961 report is at river mile 99.8 which is 1/10th of a mile below Diablo Dam. **NOTE**: No mention of 1896 flood.

[1] James E. Stewart

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		canyon below but in a big flood these obstructions would last such a short time that the great amount of sand seen could not have been deposited." "Mrs. Davis states 1897 and 1917 floods just same height, 1 ft over floor in a small bunk house near where they live." **NOTE**: See "flood notes" 9/16/22.	At least in his notes he talks about log jams. "The canyon below" like the Dalles?
7/?/18	Skagit River Flood Report by JES	This is the first report JES wrote about Skagit County. There is an interesting handwritten note on the cover stating "GLB[2]: Note: I believe all references to 1820 flood in this draft for Sedro Woolley and Concrete are for 1856 flood in later reports. HEB"	**YEAR / CONCRETE / SEDRO** **1897 / 205,000 / 171,000** **1909 / 185,000 / 169,000** **1917 / 175,000 / 157,000**
9/16/22	Transcription of JES "flood" notes on 9/16/22 by USGS 6/30/23 re Reflector Bar near Marblemount	JES returned to the Davis ranch on 9/15/22. "The trip was profitable as faint evidence of the large flood could be traced on the left canyon wall across from where I was. By hand level this was found to be 18.0 feet above water surface of Sept. 15., 18.0 plus 3.3 equals 21.3." "The wave crest of the 1921 flood is about .7 ft below that of 1909 at the 1909 high water mark at Stetattle Creek. The 1921 flood was about .6 or .8 below 1909 flood at the Davis ranch. The 1921 flood came so near that of 1909 in the canyon above Reflector Bar gaging station that they cannot be separated by observation from a distance. The rapid dimming of the 1909 flood marks, the difficulty of finding the early flood mark on the trees where it was bright in 1879, the freshness of the river sand and gravel where the river topped the bank at Reflector Bar, the condition of the Cedar stump at Ruby: all these lead to the assumption that the great flood was that of December 4, 1861. The old Indian who told Hart and others at Sedro Woolley in 1879 that the flood was when he was a boy either referred to another flood or	December 4, 1861?? This is the only time anywhere this date is mentioned. Here he states the "Old Indian" is wrong but in his 1923 report he quotes the "old Indian".

[2] G.L. Bodhaine

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		they did not understand him." There was a "later note" (unknown when) which stated "Data with measurement of May 2, 1918 makes the crest 15.0 ft. use it in preference." **NOTE:** See "flood notes" 5/2/18.	
11/16/22	Ltr to Frank Gilkey, Skagit County Engineer fm USGS re reply to Gilkey 11/14/22 ltr re BOC passing resolution authorizing a survey of Skagit River flood conditions. **NOTE**: Only first page of letter copied.	USGS informed Gilkey that a committee of citizens of which Mr. H.L. Willis was chairman, visited USGS on October 26 and asked what could be done in determining the volume of flow in Skagit River during the December 1921 flood and the magnitude of that flood when compared to past floods. "The committee was told that a recent curtailment of funds used in cooperative water resources investigations carried on by this office made it impossible for us to bear any part of the expense of this survey." "…an offer was made to the committee to detail one of our engineers to the work provided the county would pay his salary, expense, and other cost incident to the work. … "Fortunately Mr. James E. Stewart, an engineer from this office, is exceptionally well qualified for flood studies. In fact he has collected considerable information regarding early floods in the Skagit Basin. He was formerly employed here, then transferred to Hawaii where he had charge of water resources investigation and has just recently returned.	
11/24/22	JES FIELD JOURNAL	See transcription of JES Field Journal at the end of this table.	NOTE: ATTACH FIELD JOURNAL TO END.
3/13/23	Document titled "Skagit River Near Sedro Woolley, Revision 1908—1922, authored by JES.	This is a 15 page document that deals with gage height and rating curve corrections to JES previously reported data. Includes such statements as"…possibly staff gage was re-installed in December 1909 at 1.00 ft higher datum than prior to 1909 flood." "Prior to 1911 the river flowed around Sterling Bend in a much longer channel than thereafter. Hence the slope past the gage would be less than for the 1921 flood." "Choking effect of the	ADD COMMENTS ABOUT "SERIOUS ERROR"

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		NPRR bridge was greater during the 1909 flood than during later floods because of the greater discharge." These two "causes mentioned would make the slope in 1921 much greater than in 1909. Cause #2 would make the difference between 1909 and 1921 floods greater just above the NPRR embankment than just below it." **NOTE:** NPRR was at the Hwy 9 bridge. "…no measurements made during the periods November 6, 1908 to August 25, 1910 and September 20, 1919 to November 20, 1922." "…measurements by F.F. Henshaw have been accepted as being as good as other doubtful features of the measurements warrant. These other features are: 1. Measurements made from ferry. Survey experience is that boat measurements are unsatisfactory. 2. Meter rating unknown. 3. Method and accuracy of obtaining width of river unknown. The flood of December 30, 1917 caused a large low water shift probably due to deposition of large quantities of sand and gravel at the lower end of Sterling Bend cut off. The lower end of Sterling Bend cut off is the location of the break in gradient between the steep valley gradient and the delta gradient. As a consequence when the stream is loaded with material, to its carrying capacity in the upper section, it is forced to deposit at the break in gradient. It is thought that there are several causes entering in the erratic results at Sedro Woolley as follows: 1. Change in stream bed gradient at lower end of Sterling; 2. The river channel on the delta does not have as much carrying capacity as the river down to Sedro Woolley. The water floods the Nookachamps country, in fact creates a vast reservoir. The backwater from the river channel and reservoir undoubtedly affects the rating at the Sedro Woolley station.	

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5/5/23	Ltr to Frank Davis, Skagit Power Camp, Via Rockport fm JES in Pittsburgh, Pa., re Reflector Bar and requesting Davis assistance in finding evidence of the "extreme flood".	"I have determined the approximate year of that great flood which reached a gage height of 20.8 at Reflector Bar. … The flood, according to the age of the trees, occurred about 1856." "At The Dalles I found traces of still greater flood or floods. These traces mark the maximum flood or floods in the last few thousand years. I am writing you to ask if you would try to obtain evidence of what gage height the maximum flood at Reflector Bar. By comparison of the floods at The Dalles, I would estimate that this flood reached a gage height of approximately 25 feet at Reflector Bar." Stewart went on to describe how to find "flood sand" as he did in same day memorandum to Judd.	How could he know this if the flood marks disappear after a few years as he later states? If in fact the "maximum floods" were caused by debris flows or log jams coming in from the Baker or the Sauk the gage height at Marblemount would not have shown this.
5/5/23	Memorandum to T.N. Judd fm JES re flood heights at Reflector Bar and requesting Judd's assistance in finding evidence of the "extreme flood".	References "flood investigation" he did "last September. States he "accomplished very little as the bark on the trees seemed to be filled with wind-blown sand instead of flood sand." "Since last Sept. I have determined the approximate date of the great flood that I had found traces of at Reflector Bar. This flood occurred about 1856 instead of 1820, as previously estimated." "Since my visit in September I found at The Dalles near Concrete that there was a larger flood than the 1856 flood – the flood of Indian tradition that occurred about 1820 may have been the one that reached that state." Stewart requested Judd to "cut down trees on the bench" in order to determine when the trees began growing before or after the "extreme flood". Also wanted Judd to look for "flood sand".	Now the great flood is 1856 instead of 1820 or was it December 4, 1861? Now the "Old Indian" is right again.
5/23/23	Ltr to Frank Davis, Davis Ranch, Rockport fm JES in Pittsburgh, Pa., re temperature and rain records.	JES was having trouble fitting the 1917 flood into his profiles. He asked Davis for assistance. He stated, "The comparison with the 1917 flood does not work out well and I wonder if you can make any suggestion as to the reason." JES then offered several suggestions as to the discrepancies including: Snow around Davis house in	

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		1917 but not in 1921; Chinook wind did not hit around Davis place in 1917; thermometer not working properly; and "Readings that I have received may be incorrect…" He then went on to state: "It may be that at some time an enormous snow slide dammed the canyon between Ruby and Reflector Bar, and then broke loose, such an occurrence would check with the old Indian tradition of a flood about 1820 that came unexpectedly in the night and so quick they hardly escaped (Sedro Woolley Indian tradition). … "If the river should stop rising or fall before the temperature fell or before it stopped raining, it would mean there was a snow slide or jam in the canyon and the water would be down a little later carrying everything before it."	His readings "may be incorrect".
5/31/23	Ltr to JES fm Frank Davis, Davis Ranch, Rockport re Davis examination of high water marks at Reflector Bar.	Davis reported that he found "Drift sticks and bark at gulch at 16.3' elevation". He found "course wash sand at 19' elevation". He found "fine sand, probably wash at 22' elevation." "I found no course sand here but there is no doubt about the wash sand at 19." … "Drift at 16.3 does not appear to be very old and was ***probably*** put there in 1909 though it would seem to be most to high for that." **NOTE**: The measurements were taken with a hand level. Davis added a PS to his letter, which stated, "19 is just about the highest point on Reflector Bar flat."	
6/21/23	Ltr to JES from Joe Hart re flood information.	Hart acknowledge receipt of letter from JES on June 12, 1923. "The Winter floods previous to the Spring flood of 1894 was about 2 feet higher, but they were never as high or no indications of them being so, excepting the one big flood the Indians tell about. The Winter Floods since that time (1894) were always higher. The more they diked the river close to it, the higher the floods have been." **NOTE:** Joe Hart lived on what is today known as Hart's Island just upstream from Sterling. Currently owned by Leonard Halverson.	

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7/6/23	Ltr to Frank Davis fm JES acknowledging Davis ltr dated 5/31/23 re Davis and JES discrepancies in field observations.	JES states that he was at Reflector Bar "last September" in the same "gulch" that Davis made his measurements. However, "I determined with a hand level the height of the 1909 and the highest flood. I made them 15.8' and 21.3' which is .5' and .7' respectively lower than your results. … "it would seem as though one of our hand levels was out of adjustment or something else was wrong." JES wanted Davis to have his level checked because JES had "no way of checking up my data". … "In case your data proves correct in all points, I will probably want to use it instead of mine. For the time being I am averaging our results." JES wanted to know if Davis was "confident that the coarse sand at g. ht. 19 marks the crest of some flood? If it is the crest of a flood … it marks the flood of 1856." JES remarked, "The fine sand is undoubtedly flood sand, and marks the crest of the maximum flood which occurred about 1814 (within 10 years either way). I got the elevation 21.3 from the faint line on the rock wall opposite the small gulch we both worked in. You can plainly see the mark on the same flood on the rock wall opposite the Thunder Creek gage. I found the flood reached to 20.8 at the Reflector Bar gaging station." **NOTE:** See JES "flood notes" 5/22/18 and 9/16/22.	
8/22/23	Ltr to T. N. Judd fm JES re wtr levels at Reflector Bar in error.	"The data I have previously furnished you are somewhat in error as to dates and heights of certain floods. It would be well, therefore, to consider all previous data superseded in reading this letter." "The maximum flood, which has occurred in the last few thousand years, had a discharge of about 120,000 second-feet at Reflector Bar. This estimate of discharge may be in error as much as 20 percent. For engineering purposes it would be necessary to plan on handling 145,000 second-feet at that point, and about 155,000 at the Power Camp." "The flood of December 12, 1921 had a discharge of 63,000 second-	

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		feet at Reflector Bar. The estimate of discharge is believed to be within 10 percent of correct. The maximum possible estimate for the 1921 flood would, therefore, be 70,000 second-feet at Reflector Bar and 75,000 second-feet at the Power Camp." "The discharges that I have given are therefore in excess of what would be computed by using the mean of waves and surges (the USGS method)." For the 1921 flood, I believe Mr. Parker is expecting to publish 57,000 second-feet or 6,000 second-feet less than I have given. There are certain arguments for both systems of computing flood discharges. Personally, I am of the opinion that the true peak discharge would be very nearly a mean of the discharge obtained by the two different methods of obtaining gage heights.	
5/4/25	Ltr to G.L. Parker, USGS fm JES living in Pittsburgh, Pa. re status of Skagit Flood Report.	JES acknowledged the typewritten portions of the Skagit Flood Report that were transmitted with Mr. Calkins letter. "I regret to say that I have no more of the report ready for typing. My family (including myself) had a protracted siege of the influenza just after I asked you for some information concerning Baker River. In my hydrographic studies for the West Penn Power Company, I have had a chance to go into much more detail than was generally possible for any of us in the Survey. As a result of these studies, I have about come to the conclusion that for many, if not practically all, of the steep sloped streams the Survey records for maximum flood discharge are too low, except where they are based on discharge curves, the upper extensions of which were derived from area and mean velocity curves. "…I consider the trouble to be due to extending the rating table by the continued use of the last difference derived from the rating curve. In some cases, I believe a contributory cause has been the use of .2 or surface velocities with reduction coefficients to mean velocities	

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		based on measurements made at much lower stages, and consequent coefficients that are too low. Lastly, I believe that in many cases no account has been taken of the over-flow that occurs when the banks have been topped. However, in allowing for such over-flow I believe there is more danger of over-allowance than under-allowance, due to the fact that in many cases there is dead water, a large coefficient of roughness, and other factors tending to reduce the flow much below the figures for the main channel." **NOTE:** The above verbiage seemed to deal with calculations for all rivers in Washington and not just the Skagit as he later references several other river basins. Later he states: "I have brought this feature up at this time because I believe that the Skagit River flood discharge at The Dalles can better be determined by an extension of the rating curve with the use of area and mean velocity curves based on the highest convenient .2 and .8 depth measurements than by attempting extreme high flood measurements." … "The highest flood measurements made at The Dalles should be used in checking up the coefficient of roughness that I used in my slope calculations. … One factor that should be remembered in this connection is that the slope cannot be used for 500 feet or more below The Dalles. This is due to the reduction in velocity head in that stretch of the river for high stages. In fact, for extreme high stages there is an upstream slope for some distance below The Dalles."	
1/28/29	Preliminary Report—Stage and Volume of Past Floods In Skagit Valley And Advisable Protective Measures Prior To the Construction Of Permanent	There is a handwritten note in the file that this is the document that was given to the Skagit County Commissioners in October 1923. However, the date on the signature page is 1/28/29 so I have no idea if it is the same document or not. The document is 27 pages long and could very well be the first chapter of his unpublished	

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	Flood Controlling Works	report in 1923.	
4/2/46	Letter to William Eisenlohr, Jr., Hydraulic Engineer, USGS, Wash. DC from JES re Skagit Report	JES is informing USGS that additional field work needed to be done. "The most important field work is checking the "N" for the slope sections used at the Dalles. This checking of the "N" can be done by Mr. Veatch's office alone.	Important to note is that at this time JES is no longer employed by USGS and hadn't been for many years. He left USGS in March 1923, 7 months before his report was completed and given to the Skagit County Commissioners. (See 6/1/50 letter)
6/1/50	Letter to FM Veatch, District Engineer, USGS, Tacoma, WA from JES	"In April and May 1946 we had some correspondence regarding the possibility of slope measurements below "The Dalles" on Skagit River near Concrete." "…the proposed slope measurements would be made so as to check (using the gaging station rating) the accuracy of the value of "N" used in my 1923 computations for previous large floods at "The Dalles. In March 1923 … I had to leave Tacoma before I had completed the Skagit River Preliminary Flood Report (which contains all of the material previously promised to Skagit County). The most important work not accomplished at that time, due to lack of a gaging station at "The Dalles", was checking the value of "N" used for the slope sections." Attached to the letter was a memorandum in which JES made recommendations for the "slope section". He stated in part, "To counteract the uncertainties involved in velocity head gain or loss, it is advisable to take several sections and average the results obtained from them. In 1922-1923 cross-sections were taken at 618—2,749 and 4,655 feet downstream from the mouth of "The Dalles". It is suggested that for this important check-work five cross-sections be taken, say about 700—1,700—2,700—3,700 and 4,700 feet downstream from the mouth of "The Dalles". It is important that the first one of these below The Dalles be far enough below so that all of the	4 years later and no one had contacted JES that slope measurements had been done by USGS in 1949 one year before this letter. (See 11/14/50 entry) The significance of this statement is that the Corps and USGS had been using JES flood estimates in their publications for decades prior to this letter being sent although clearly "the most important work" had not been accomplished. There is no indication in the files that this was ever done. In fact the 1921 flood was calculated later by USGS using a "reach" of 2,190 feet with a fall of 2,062 feet based on the river level of the November 27, 1949 flood event. (See 5/5/52 entry).

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		velocity head gained in The Dalles is lost; i.e. that the water has at least reached its maximum level resulting from the loss in velocity head. Another feature of some importance, although how much is uncertain, is the amount of surging in the stream at the ends of the sections during the crest of the flood. Manifestly the only elevations available, when the flood crest is based on high water marks, is the crest of the surges, whereas what is needed is the mean level of the water at the time of the flood crest.	Again, no indication in the files this was ever done.
11/14/50	Proposed Revision Of Skagit River Flood Peaks by H.C. Riggs and W.H. Robinson, USGS	This report analyzed JES flood estimates for both Concrete and Sedro-Woolley. **Concrete**: "On the basis of a slope-area study made in the reach below the gage for the flood of November 27, 1949, it appears that the value of "n" used by Stewart in his 1921 flood flow computation was too low for his upper reach. It was also noted that Stewart did not take into account changes in velocity head in his computations. A recomputation of the 1921 peak by present methods using Stewart's values of A, P, and f, and "N" = .040 for the upper reach and "N" = .033 for the lower reach gives 209,000 cfs." … "I can find no data on which to base an estimate of the percentage of energy recovery for various conditions, but it might be that much of this energy is lost in moving the gravel bottom of the stream." … "The need for revision of the historic flood peaks is supported by the logarithmic extension of the present rating curve. … at those times the overflow area was heavily timbered and would carry little water. In addition, the possibility of a reduction in slope due to log jams downstream is to be considered. The recomputed value of 209,000 cfs mentioned above checks this logarithmic extension within 2%. The flood frequency curve shows a sharp offset to the right between recorded and historic floods and casts further doubt on the published values for the historic floods.	The new values for the JES historic floods at "The Dalles" were proposed as follows: Year JES Revision 1815 500,000 400,000 1856 350,000 280,000 1897 275,000 230,000 1909 260,000 220,000 1921 240,000 210,000 1917 220,000 190,000 The allowance for log jams or other obstructions is what has been missing out of all the former computations.

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		Sedro-Woolley: "There was little basis for the original extension of the rating curves at Sedro Woolley. … The extension of the rating curve for the 1921 flood is based on measurements made during 1922-23. … The flood of Nov. 28, 1949 reached a stage of 41.7 ft (USGS datum) at Sedro Woolley. Measurement No. 76 shows the datum then in use (prior to 1923) to be 8.93 ft higher than USGS datum. Then the 1921 flood was higher than the 1949 by 54.3 – 8.9 -41.7 = 3.7 feet. … The great difference between the 1897 peak near Concrete and near Sedro Woolley must be due to the extreme sharpness of the peak.	The new values for the JES historic floods at Sedro Woolley were proposed as follows: Year JES Revisions 1815 400,000 330,000 1856 300,000 230,000 1896 185,000 170,000 1897 190,000 170,000 1906 180,000 160,000 1909 220,000 190,000 1917 195,000 160,000 1921 210,000 170,000
1/25/51	Skagit River near Sedro Woolley – Revision Of Historic Flood Peaks by F.J. Flynn, USGS	Just two months after the Riggs and Robinson report, another USGS hydrologist looks at the Sedro Woolley figures again. He states in part, "Control conditions are such that an extension of the rating at Sedro Woolley is subject to much greater doubt than the extension of the rating at Concrete. The assumptions made in the analysis by R&R appear generally reasonable and the proposed revisions should be better than the originally published figures. However, it is possible that the proposed figures for 1909, 1906, 1897, 1896 are still too high." "This cut-off about a mile downstream from the station cut more than two miles of river channel around the bend. …it appears that the 1909 peak at Sedro Woolley could be as low as 165,000 cfs. If a curve over to left is logical for 1909, it probably should be used for the 1906 flood too, and maybe all the prior floods."	Flynn was concerned about the impacts of the Sterling Bend cutoff which occurred in the 1911 flood which according to USGS records only carried 66,600 cfs. Stewart included in his report that this cut-off was "sided by dynamite" which strongly suggest this was not a natural occurrence.
5/5/52	USGS Slope Area Measurement of Skagit	Flow calculated at 226,000 cfs. "N" was calculated using .030. Note states: "Only reach B-C used. Reach A-B is	

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	River near Concrete for December 13, 1921 flood computed by MAB[3]	expanding and "n" for that portion of the channel is not well verified. Value of "n" for reach B-C is from verification using data from flood of November 27, 1949.	
8/52	Skagit River near Concrete, Wash. – Verification Study by F.J. Flynn and M.A. Benson	This report was originally written by F.J. Flynn on 1/25/51, but was revised by Benson and presumably Flynn in August, 1952. The peak discharge of the flood on Nov. 27, 1949 was 153,000 cfs from rating curve extended above 135,000 cfs. The rating is defined at high stages by a series of measurements made in 1932. "The peak discharge for the flood of Dec. 13, 1921 was originally computed by JES … as 240,000 cfs. … Using JES values of fall and area and wetted perimeter of the sections the peak discharge of the flood of Dec. 13, 1921, was recomputed as 209,000 cfs with values of "N" assigned on the basis of those determined for the flood of Nov. 27, 1949. … Stewart's section 1 was about 300 feet upstream from sect. A of the 1949 flood; his section 2 was between sections B and C; and his section 3 was about 700 feet downstream from section D. There appears from the stereo-realist slides to be very little likelihood of much change in conditions in the reach since 1921. … After adjusting the areas for the difference in stage between the two floods, there appears to be practically no change between 1921 and 1949. … The writers believe that there is little basis for using a higher "N" in the upper part of the reach than in the lower part. They feel that an "N" computed for the reach B-C-D is more logical. They also feel that only the reach 2-3 of Stewart's 1921 determination should be used in computing the discharge because reach 1-2 is expanding and the "N" for that reach may be questionable. Using Stewart's values of Fall, A and r and the 2-section	So does this mean that this whole computation was done with pencil and paper and had nothing to do with actual measurements of the 1949 flood? This statement is in direct conflict not only with verbiage contained in this report but with the note contained in the 5/5/52 slope area measurement, "Only reach B-C used. Reach A-B is expanding and "n" for that portion of the channel is not well verified." So based on a "belief" (i.e. an assumption) and using JES figures they recomputed the flow to be 225,000 cfs???

[3] M.A. Benson

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		formula, the writers have computed (unchecked) a discharge of 225,000 cfs using an n of .030 (as determined by the 3-section formula for verification study). In memorandum by Riggs and Robinson dated 11-14-50, there is listed proposed revisions for historic floods. These revisions are based on a straight line extension of the rating curve on log-log paper. However, some of the proposed revised figures actually fall to the left of the straight line extension (those for 1856 and 1897). The writers does not have any data upon which to judge the reasonableness of the straight line extension. However, it should be realized that a wide overflow section many miles downstream from the gage could cause the rating to bend to the right. Furthermore, if the discharge for the 1921 is plotted at gage height 47.6 feet and 225,000 cfs it indicates a break to the right. On the basis that the peak for the 1921 flood as computed by JES (240,000 cfs) is too high and that the rating now in effect and also in 1921 was the same all the way back to 1815, then the published values for all the historic floods are also a little too high but the highest flood (1815) may be correct. It is felt that the proposed revised figures as listed in the memorandum are too low. After the computation of the 1921 flood is checked, we would favor extending the rating exactly through that point.	It has been documented that more likely than not that the 1856 flood was a debris flood coming out of the Baker River. Since the Dalles is one mile below the Baker River and a very narrow canyon as compared to upstream and downstream conditions is also more likely than not that several log jams occurred in this area. In JES Field Notes is the following notation: *"Leonard Everett says 1897 flood about 9 inches lower than 1909. Says that log jam in the Dalles raised water 10 feet in 2 hours. Considerable distance and slope between 1897 and 1909 and 1921 marks."* Depending on how you want to read the notation either the 1897 flood or the 1909 flood had a major log jam at the Dalles. There is no indication that Bensen or anyone else at USGS ever reviewed the Stewart field notes.
1952	USGS table listing flood events in order of their discharge at Concrete.	The initials at the bottom are HCR[4]. Under that is another entry listing GLB[5] 5-20-56. There are penciled in changes to the discharges for the 1856, 1897, 1909, 1921 and 1917 flood events. Interesting to note is that the most serious flood events at Concrete after the 1917 event are the 1949 (154,000) and 1932 (147,000) and	

[4] H. C. Riggs
[5] G.L. Bodhaine

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		the 1951 (139,000), all post gage installation and dam construction.	
1/28/53	Letter to JVB Wells, Chief, USGS Surface Water Branch, Wash DC, from FM Veatch, District Engineer, USGS Tacoma re status of Stewart Report	States, "Several years ago this office sent to Washington the basic material for a report on the floods of the Skagit River in this state. This had been prepared originally by James Stewart about 30 years ago. Some additional work was done on the report in Tacoma and Mr. Eisenlohr did quite a lot of it in Washington before returning it to us. He did not have time to complete it. It lies here unfinished and would require one to two man months of work if it were to be prepared for publication." "…I believe we could complete the work necessary to be done in Tacoma for not more than $1,000."	
3/4/53	Letter to JVB Wells, Chief, USGS Surface Water Branch, Wash DC, from FM Veatch, District Engineer, USGS Tacoma re status of Stewart Report.	"Your suggestion is noted that the report be returned to Washington for a year or so on the possibility that Mr. Eisenlohr or someone in the Special Reports Section could do some work on it prior to the 1955 fiscal year. We obtained the report from Mr. Eisenlohr a few months ago, it having been shelved by him for a year or two." … "Perhaps I should await further word from you before sending the report."	
5/5/53	Memorandum to FM Veatch from Chief, Surface Water Branch re Proposed report on the floods of the Skagit River	"I am inclined to agree with Clayton Hardison that if it was worthwhile to put in time, money, and effort on this flood report 30 years ago, chances are it is worthwhile to put in another 1,000 to complete it." However, as this has already been postponed 30 years, I don not see much objection to postponing it a while longer."	
6/17/53	Handwritten note to Larry from Bill re reporting of Mt. Vernon flood flows.	Note states, "Norman McDonald, Corps of Engineers, called and said they were concerned about revisions in their State Bulletin which were put in there by Murphy. The one for the Skagit River at Mt. Vernon was one of	

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		those. It showed in the Bulletin 210,000 cfs Dec. 13, 1921 for that peak and Murphy has lined it out showing another figure. "Following that is another handwritten note unsigned which states, "I called on **July 24, 1961** and told him to use the original figures. The suggested revisions were dropped after further analysis."	
8/21/53	Memorandum to FM Veatch from Acting Chief, Surface Water Branch re Proposed report on the floods of the Skagit River.	"We are issuing a project authorization in the amount of $1,000 for the completion of this report during fiscal year 1954."	
8/00/53	Handwritten note to GLB from FV re assignment of report.	"Now that we have the $1,000 allotted, we must prepare the Skagit flood report for publication. That will be under your immediate supervision."	
1/12/54	Handwritten memorandum titled Skagit River near Sedro-Woolley, WA – Proposed Revision of Historical Flood Peaks by F.L. Hidaka, USGS	"Measurements 4-10 were used in the definition of the rating tables dated March 17, 1923, which was the only curve which was defined in the upper end before Sterling Bend was cut-off by the river in 1911. A definite change is believed to have taken place after the bend was cut-off causing the rating curve to plot to the right. … Based somewhat on the discharges which were determined for Skagit River near Concrete and upon the elevations of the flood as determined by Stewart, a tentative curve has been drawn. This curve shows less water then obtained at Concrete because of the short duration and the intensity of the flood which due to channel storage reduced the peak at Sedro Woolley. There is actually no basis for this extension except that it is not believed that the rating curve should break to the right and then back to the left. … On the basis of the tentative curve … new estimates of discharges were made for all the floods which occurred before the Sterling Bend cut-off. … It is believed that the discharge estimates for the 1917 flood	Sedro Woolley revisions are listed below: YEAR JES REVISIONS 1815 400,000 370,000 1856 300,000 260,000 1896 185,000 145,000 1897 190,000 145,000 1906 180,000 140,000 1909 220,000 175,000 The above revisions represented a

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		is correct and it checks the statement made by JES that this flood was remarkable for the length of time that it stayed up high. The discharge obtained for this flood at Concrete was 200,000 cfs while that at Sedro Woolley is 195,000 cfs. Due to the long duration of the flood, the peak discharge for this should be very nearly the same at the two stations because all the channel storage has had an opportunity to fill up and therefore, allowing the peak to proceed down the river without any reductions. The peak for 1921 should be revised on this basis to 200,000 cfs from 210,000 cfs. It is believed that the cutoff of Sterling Bend had enough effect to cause the entire rating to shift to the right and it is on this assumption that the ratings have been extended.	change of 7.5% to 23.7% in the Stewart figures.
3/18/54	Memorandum to FM Veatch from Chief Surface Water Branch re Skagit River Flood Report	"If Mr. Bodhaine started work on this report the first of February as planned, it is assumed that considerable progress has been made. Please advise the status of this project as of the end of March. We are particularly interested in how much work remains to be done and when the report can be expected to reach us. It is my understanding that the $1,000 allotted for this project was a liberal allowance based on the estimated cost. Every effort should be made to keep within that figure unless the Tacoma District plans to absorb some of the expense. The prospect of additional Federal money for this project is slim, so I hope the work can be tailored to fit the available funds."	
3/23/54	Letter to JVB Wells, Chief, Surface Water Branch, USGS from FM Veatch re status of Skagit River Report	"Mr. Bodhaine did considerable work on the report in February, but very little in March … It is anticipated that the report can be furnished to your office by the last half of May. The greatest amount of work remaining is on "Flood types and frequencies". Under the title Material to be completed was included: (3) Flood lists and frequency curves; (4) Text and graphs of flood types and	

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		frequencies.	
5/13/54	Skagit River Flood Peaks, Memorandum of Review by G. L. Bodhaine, USGS	"A decision must be made soon concerning the revision of the flood peaks determined by JES at the gaging stations on Skagit River near Concrete and near Sedro Woolley." **Concrete:** "The 1921 flood peak near Concrete seems to be the logical point through which to extend the rating curve for this station. Benson's computed discharge of 225,000 cfs has been checked and seems to be a reliable figure. A logical extension of the rating curve passes through this point and the 1815 flood peak of 500,000 cfs. … The newly suggested values all differ from those of Stewart by less than 10% so perhaps they should not be revised." **Sedro Woolley**: There is no firm basis for extending the rating curve for this gaging station because of dike breakage and the lack of good high water measurements. Measurement 1-10 was made before Sterling Bend was cut off in November 1911. During the next few years considerable changes took place and by 1917 the low water rating had changed by about 3 feet. The effect on the high water rating is unknown because it was not well defined before Sterling Bend was cut off. … Scour is an unknown factor. A small piece of evidence that the river did shift considerably after Sterling Bend was cut of lies in a letter Mr. Veatch received from Mr. Nordmark … in June 1944. Mr. Nordmark stated, "As you know the floor of the river dropped several feet and the water table as measured in wells in the vicinity dropped about 6 feet." This statement was made in reference to the elimination of Sterling Bend. … The writer questions the theory that the peak discharges near Sedro Woolley will always be less than those near Concrete. This factor is dependent upon channel storage, duration of flood peak, and intermediate inflow. In November 1949 the peak discharge near Concrete was 154,000 cfs while that near Mt. Vernon	

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		was 114,000 cfs which shows quite a reduction. However, in February 1951 the peak discharge near Concrete was 139,000 cfs while that near Mt. Vernon was 144,000 cfs which shows a slight increase. It is not known how many Skagit River floods may have been affected similarly. … The 1951 flood just reached the top of the dikes just downstream from Sedro Woolley but did not break through them. This point, then, should represent main channel flow. These same dikes broke in 1917 and in 1921 so the discharge could easily have increased to 200,000 cfs with little additional change in gage height as is indicated on the rating curve. The writer believes the 1917 and 1921 peak discharges suggested by Stewart to be quite reliable based on the above discussion. … The writer recommends that Stewart's values be used. A maximum change of 10.8% seems small when all of the possible errors are considered.	
5/13/54	Letter to Chief, Surface Water Branch, USGS, Wash. DC from FM Veatch re status of Skagit River Report	Enclosed are a series of memorandums of review and some curves and computations concerning the revision of the historical peak discharges determined by JES for Skagit River near Concrete and near Sedro Woolley. Mr. Bodhaine has written what we hope will be the final memorandum for this problem. His recommendation is that Stewart's values be used even though they are believed to be up to 11% high for some peaks.	
7/2/54	Cover memorandum attached to a draft of the Stewart/Bodhaine report from GL Bodhaine.	The memorandum had 9 "Notes for reviewers". Among them were: (3) We do not have funds (see letter to JVB Wells, dtd July 2) to do any additional work on the flood frequency study. That study is complicated by storage in the reservoirs so perhaps **the most simple study is desirable**; (5) The high-water profile is not very complete but it seemed that some sort of profile should be presented.	

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7/15/54	Memorandum titled Skagit River at Sedro Woolley, Wash., Historic Flood Peaks, , signed by F.J. Flynn re no revisions to Stewart figures.	Flynn is commenting on Bodhaine's memo dated 5/13/54. "The ratings are complicated by lack of definition, building of dikes and breaking and overtopping of dikes and the unknown effect at high stages of the Sterling Bend cut-off made in 1911. The assumptions and analysis made by Mr. Bodhaine appears reasonable and we agree with his recommendation to leave unrevised the figures of discharge for historic flood peaks.	
7/16/54	Memorandum titled Skagit River near Concrete, Wash., Historic Flood Peaks, signed by F.J. Flynn re no revisions to Stewart figures.	Flynn is commenting on Bodhaine's memo dated 5/13/54 wherein he recommended that the high-water rating be extended through a discharge of 225,000 (as computed by Benson) for the stage of the 1921 flood up to the published figure of 500,000 for the stage of the 1815 flood as determined by Stewart. "This gives a logical looking curve." He went on to state, "…the gage site and datum should be looked into and corrected if necessary in the compilation report. It appears the "Gage" paragraph of the annual repots 1951 is incorrect." "…it would appear that the flood heights…for the historic floods are at site 200 ft upstream and at same datum used Dec. 10, 1924, to Oct. 27, 1937. He suggested that the statement in the report be changed to read, "Prior to Dec. 10, 1924, staff gage at site 200 ft upstream at datum 12.7 ft higher." "When we wrote our memorandum of 12/21/45 we had no idea of the slopes involved. However from the falls measured in the slope-area determination, the fall between the two gage sites is probably on the order of 0.2 ft. … Even though the error due to neglecting fall between the two gage sites would tend to increase the percentage differences between Stewart's figures and the present curve, no changes in the published figures of discharge are warranted."	

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