Is Grohman Narrows Aggrading?

July 2011

Local citizens familiar with Grohman Narrows have suggested to the International Kootenay Lake Board of Control that the Narrows needs to be dredged once again. They offer as evidence, for one, the apparently expanding sediment bar at the outlet of Grohman Creek, claiming that it is restricting flow and aggravating high water conditions. While that evidence is quite real, comparison of a 1950s stage discharge curve with actual daily water levels and discharges during the snowmelt periods of the subsequent decades indicate that the discharge capacity of Grohman Narrows is unchanged since 1948.

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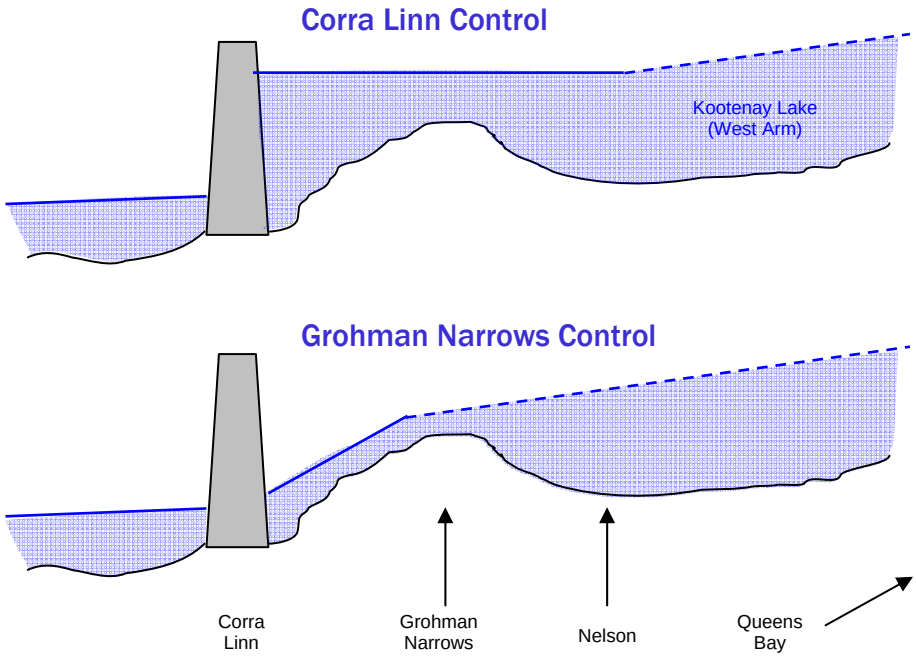
Grohman Narrows is a natural constriction at the outlet of Kootenay Lake's West Arm. It is the point at which the Kootenay again becomes a river and makes its final journey to its confluence with the Columbia. Because this narrowing regulates lake levels *(at times)*, it is considered a "control" of the lake. Corra Linn Dam sits a few kilometres downstream from Grohman Narrows. Corra Linn was designed to store (raise) water on Kootenay Lake for the purpose of hydroelectric generation. As such, it, too, is a "control" of Kootenay Lake *(at times)*.

Looking downstream at Grohman Narrows from Nelson

Since Corra Linn Dam can raise the lake to a stage that backs water up into Idaho upstream of the lake, it is subject to an Order of the International Joint Commission (IJC). The Order does two things: it approves the operator's request to dredge Grohman Narrows to enhance the usable water level range—which was done in the early 1940s; and it dictates maximum lake levels. Simply put, the Order allows the dam operators to store water in Kootenay Lake from September to early January, after which the lake must be drawn down in readiness for the spring snowmelt. During the melt period, the lake must be held at a defined stage below that which would have occurred had neither the dam been built, nor the Narrows dredged.

In actual practice, the dam is usually the lake's control point during the autumn storage period, and Grohman Narrows is typically the lake's control point during the winter drawdown and the spring/summer rise. Moving the control from the dam up to the Narrows is simply a matter of lowering the Corra Linn forebay, i.e.,

letting water through the dam faster than the forebay can be refilled from upstream. (See diagram.)



In the period during and after Grohman Narrows was dredged, considerable effort was put into studying the nature of the lake's controls. In 1941, Messrs. Patterson and Davenport wrote, *"Development of the Discharge Curve and Storage Diagram for Original Outlet Conditions"*, as a means of determining how much the lake's stage had to be lowered during the snowmelt periods to meet the requirements of the IJC Order. Subsequently, Messrs. Waananen and Patterson (et al.) conducted a series of 146 streamflow measurements from a new cableway over Grohman Narrows during the period 1943 to 1951, which included daily measurements over the peak of the 1948 flood. In their 1951 report, *"Kootenay River Discharge below Kootenay Lake: Development of the Discharge Curve for Kootenay River at Grohman, BC, Under Present Conditions"*, they developed two stage discharge curves comparing the water levels at Nelson with the discharge through Grohman Narrows. The first curve represented the period from the settlement of the Narrows after dredging to the peak of the 1948 flood. Noticing a distinct control change at Grohman Narrows at the very peak of that flood, they developed a second curve for the subsequent period. Both curves were drawn "large" of the discharge measurement points so as to represent the Narrows flowing freely without influence from Corra Linn.

The new curve was dated August 20, 1951. Waananen and Patterson ascribed it to the lake's outlet conditions since June 12, 1948 and forward. This curve and the streamflow measurements used to define it are reproduced in figure 1. The hydrologists observed that the measurements plotted to a distinct limit to the right on the graph. This limit, at which the stage discharge curve is drawn, represents the series of water level and lake outflow values at which Corra Linn no longer

exerts control on the lake level and the outlet is fully controlled by the constriction at Grohman Narrows. In addition to the Waananen and Patterson's latest curve, figure 1, for reference, also shows their pre-1948-flood curve as well as Patterson and Davenport's "1929 conditions" curve. Note that the three curves progressively move to the right indicating an increased water conveyance ability by Grohman Narrows.

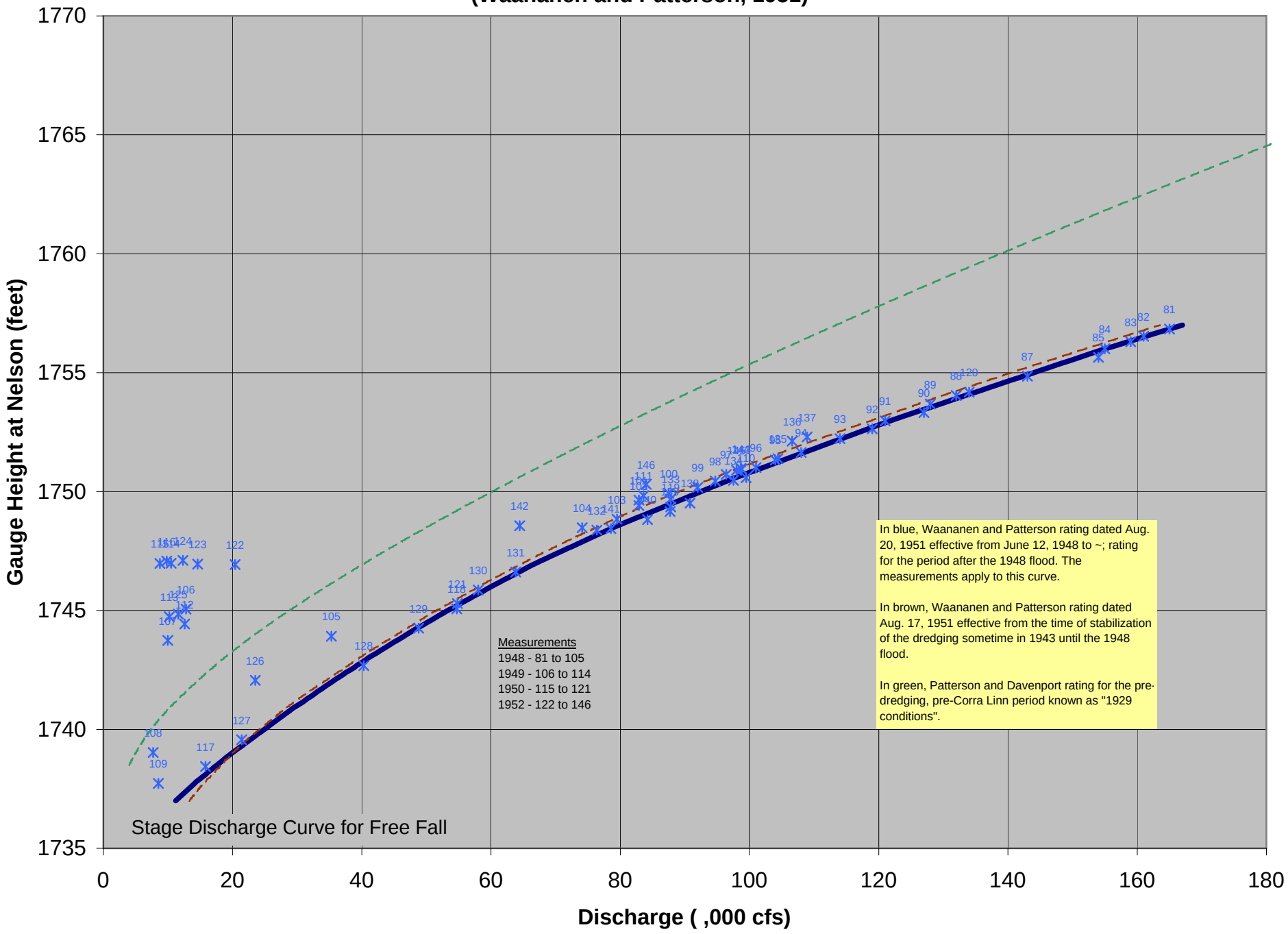
To check whether the curve still applies today and to determine whether the narrows is stable, aggrading, or degrading, data for all years from 1950 to present were plotted against the stage discharge curve. The data used each year is the daily Nelson gauge height and lake discharge as determined at Corra Linn for the period April 1 to August 31, generally representing the snowmelt period. These plots are shown on the seven graphs following figure 1. While many days each year plot to the left of the curve, indicating Corra Linn control of the lake level, the significant fact is that at least some days each year plot on the curve. This clearly shows that in the absence of Corra Linn control, Grohman Narrows is still capable of passing the same water at the same stages today as it was after the 1948 flood.

Consider the 2011 plots in particular. In 2011, the IJC's Board of Control watched Corra Linn's operation closely to ensure that the lake's control was at Grohman Narrows in advance of and during the spring rise. Almost all days this year (as of July) plot within 5% of the curve drawn in 1951. This is strong evidence that, although there may be small perturbations from time to time, Grohman Narrows is still the control it was in late 1948—neither aggrading nor degrading.

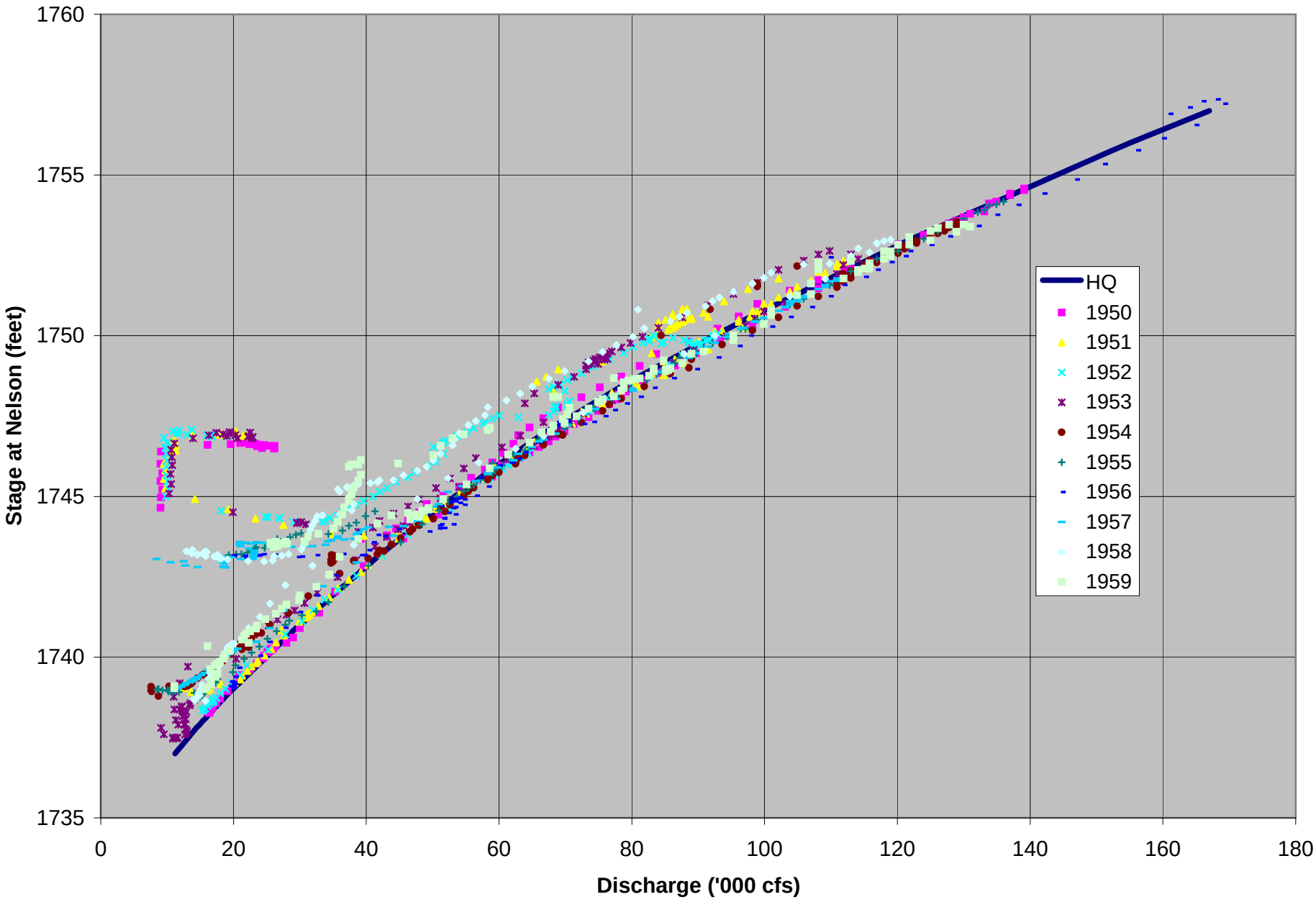
The International Kootenay Lake Board of Control invites any analysis or evidence that will either support or contest this information.

Corra Linn Dam

Figure 1 Rating Curve for Kootenay River at Grohman Narrows
(Waananen and Patterson, 1951)



Grohman Narrows Free Fall Discharge Curve
dated August 20, 1951



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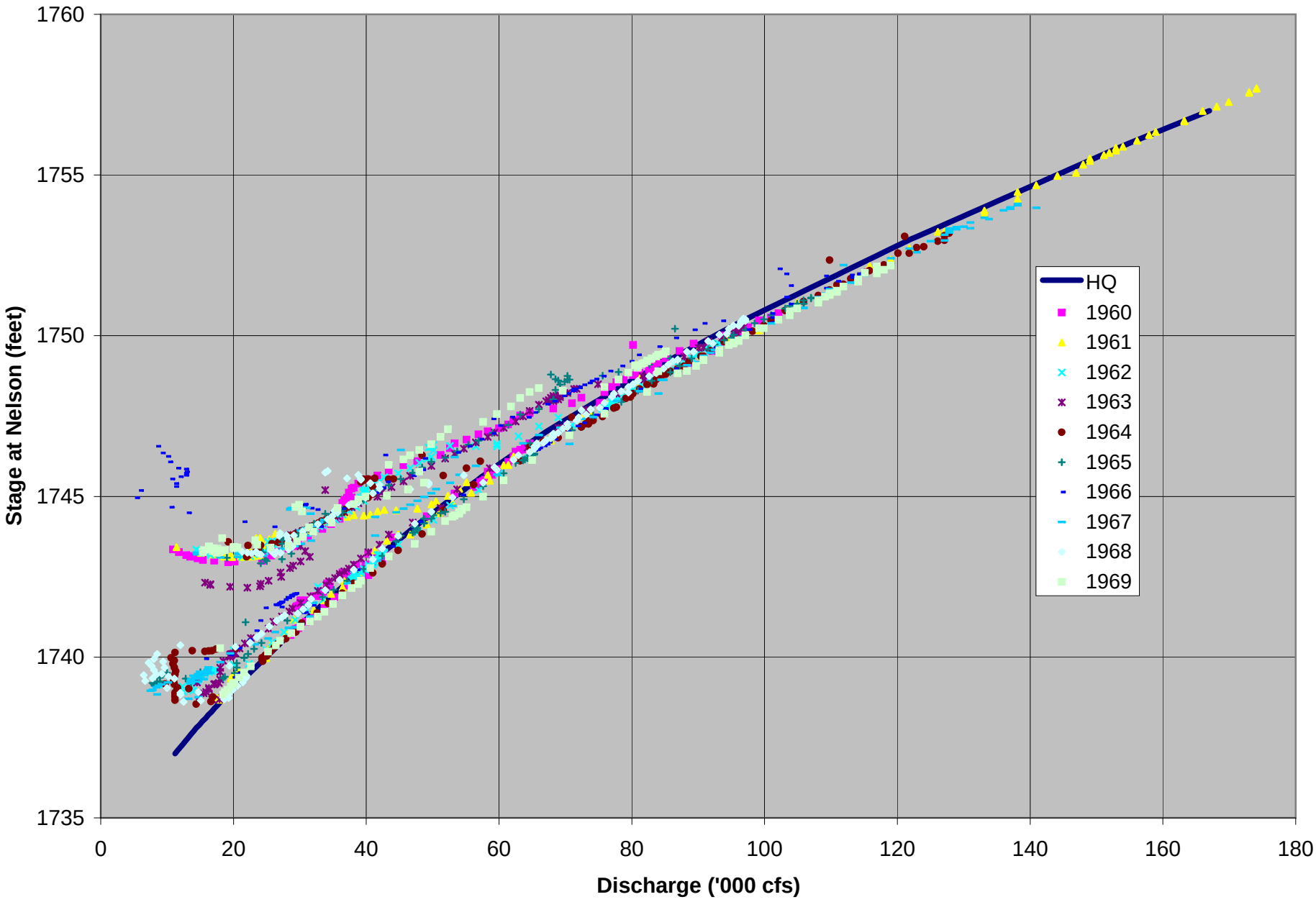

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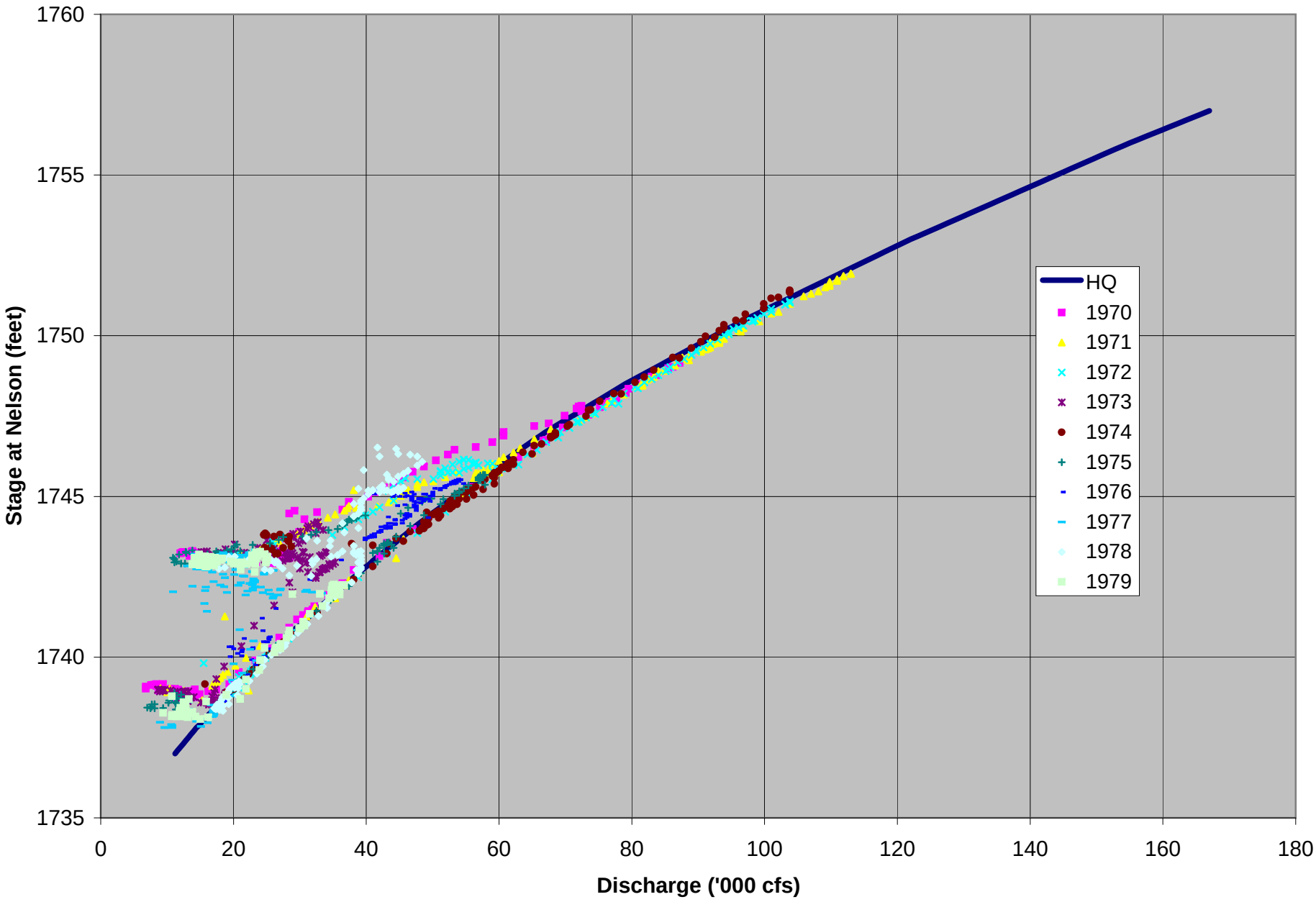
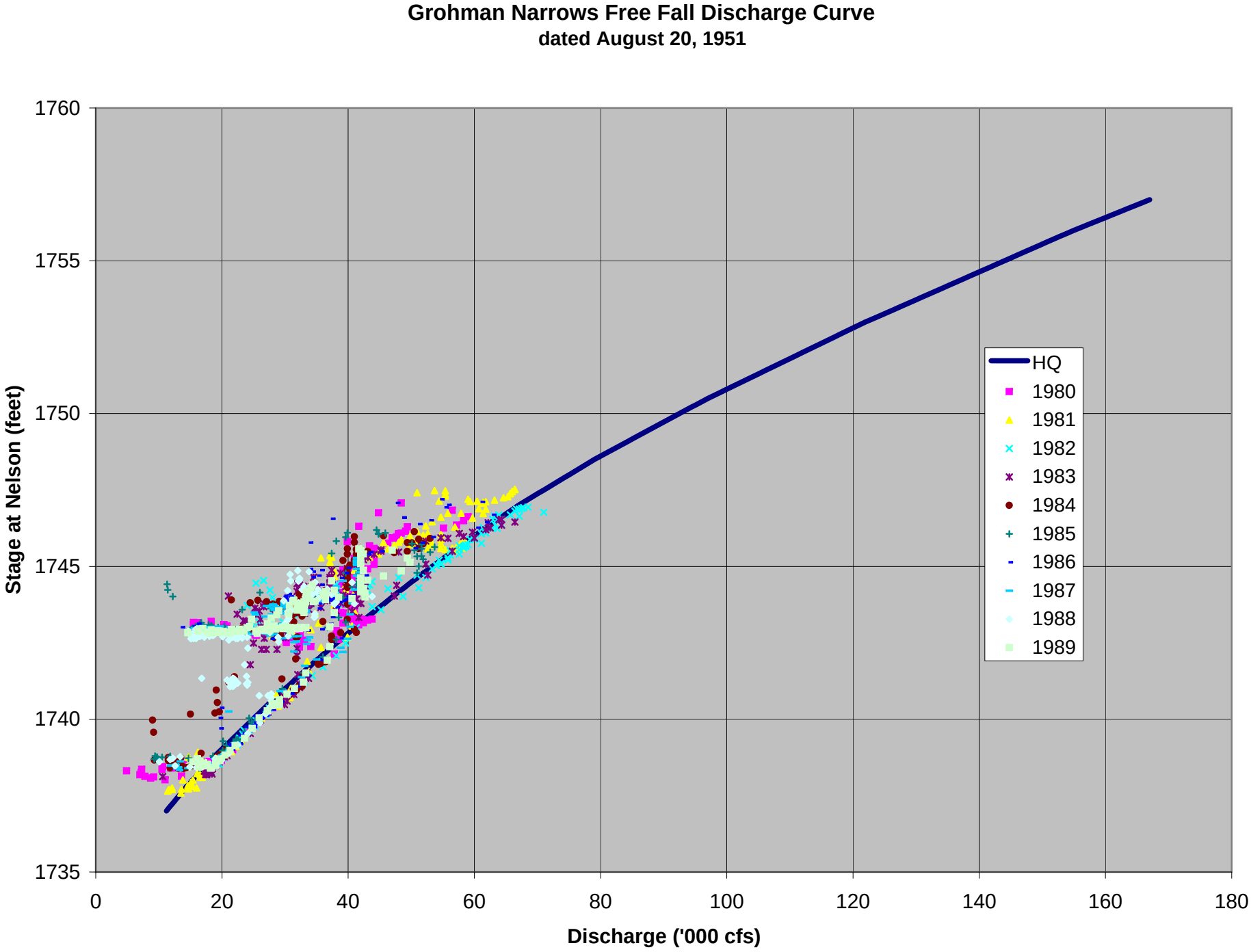
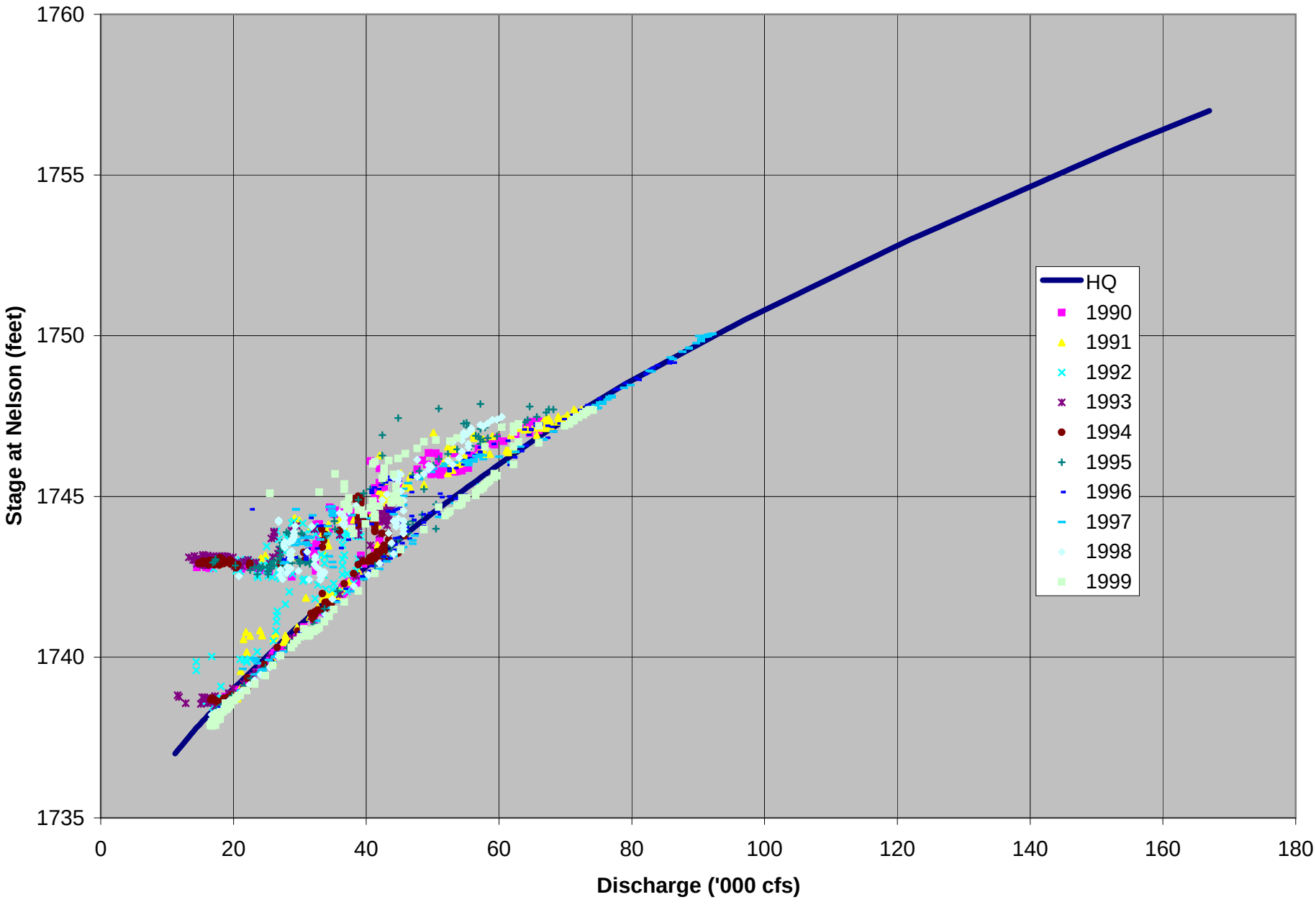



Grohman Narrows Free Fall Discharge Curve
dated August 20, 1951
Stage at Nelson (feet)
1760
1755
1750
1745
1740
1735
0
20
40
60
80
100
120
140
160
180
Discharge ('000 cfs)
HQ
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989

Grohman Narrows Free Fall Discharge Curve
dated August 20, 1951



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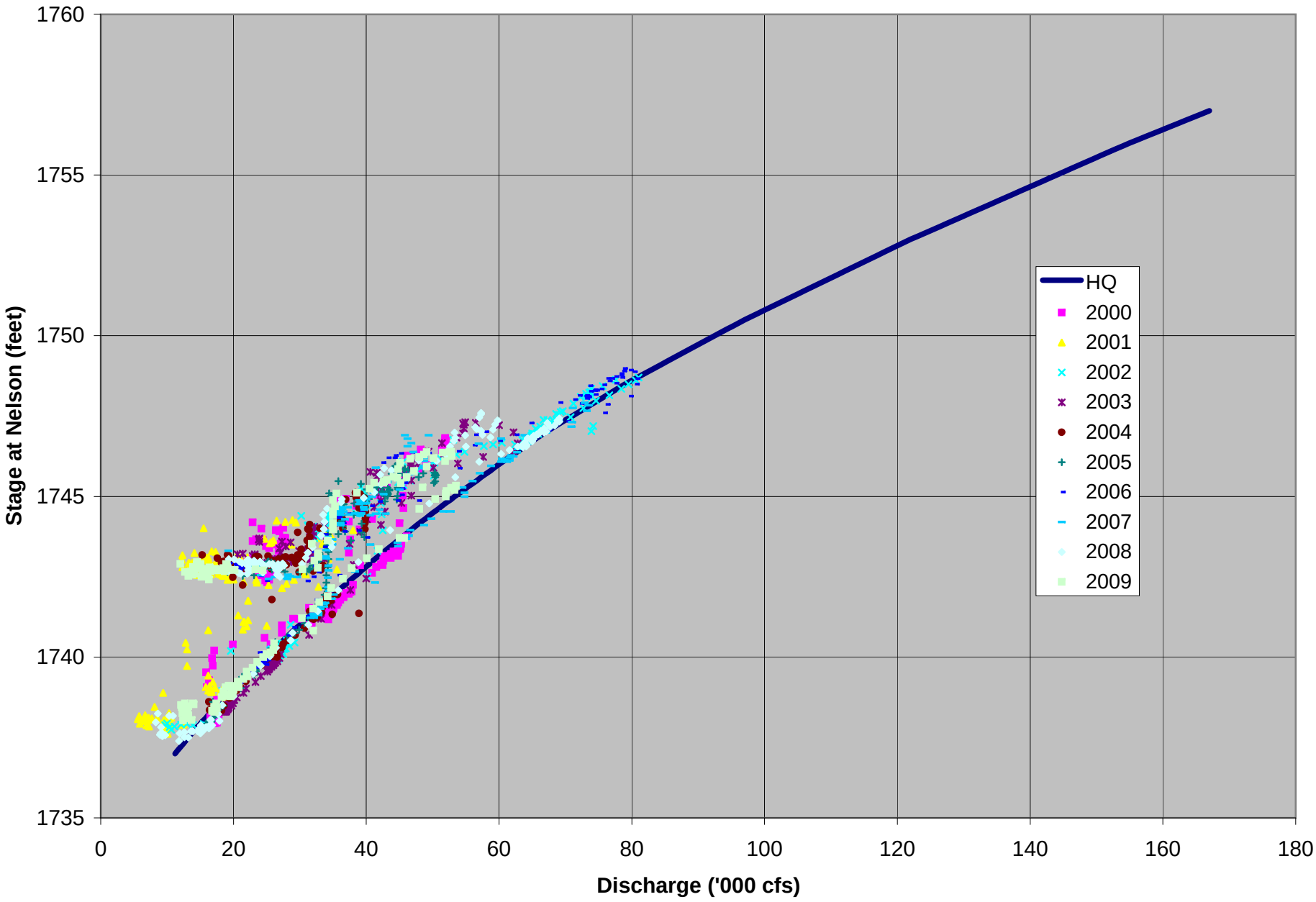

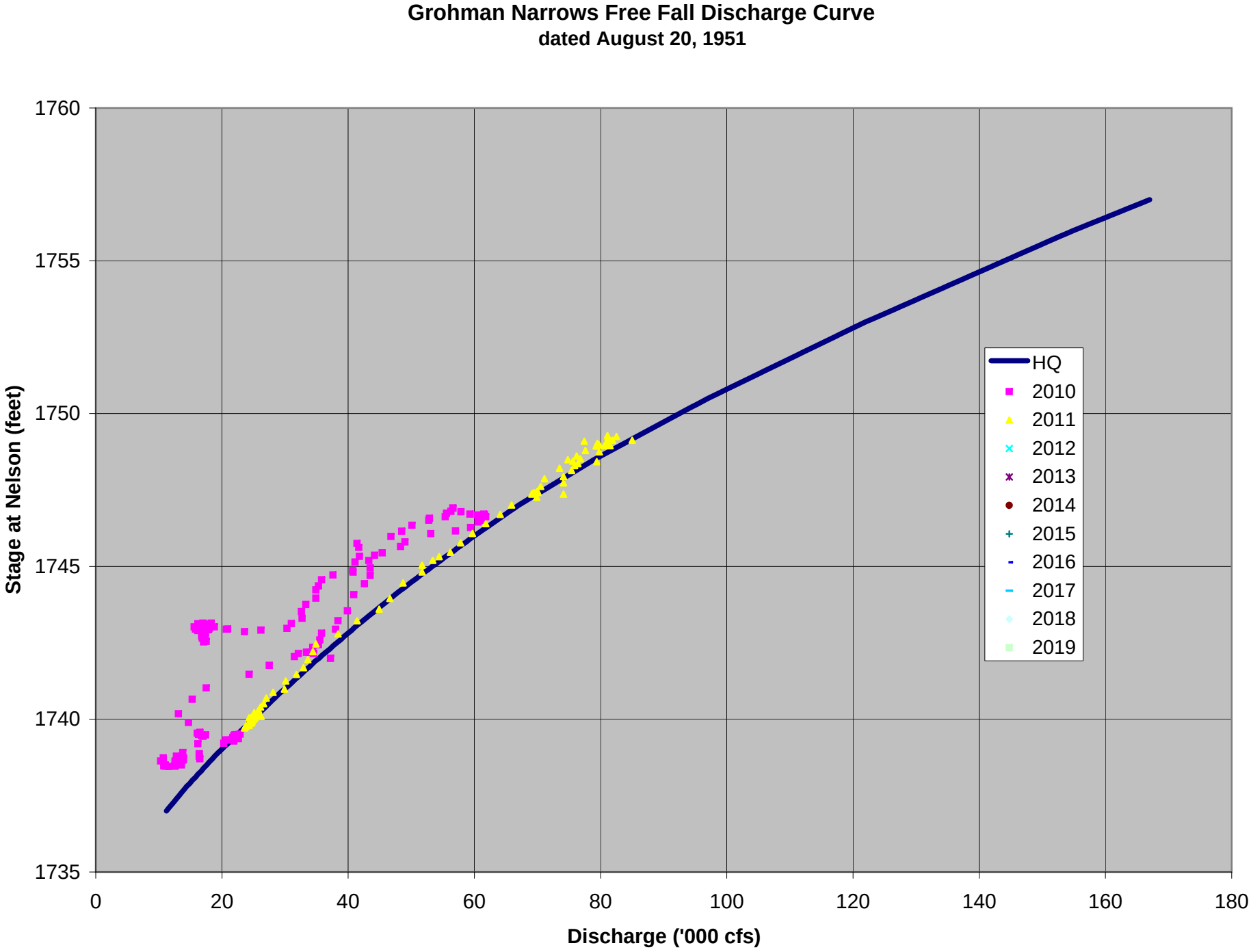
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Discharge ('000 cfs)
HQ
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019