

9. Otter Lake

Otter Lake is a 332-acre lake lying on the Anoka-Ramsey County line along the southern corporate limits of the City of Lino Lakes and within the District's Clearwater Creek Planning Region. The ordinary high water level, as recorded by the Minnesota DNR, is 911.5 (NGVD 29). Otter Lake is connected to Bald Eagle Lake by a manmade channel, and lake levels of both lakes are controlled by a weir which has a crest elevation of 910.68 (NGVD 29). Otter Lake also serves as a backup water supply source for the St. Paul Regional Water Services. The Otter Lake Conduit is a 36-inch diameter RCP constructed in 1884 as part of the St. Paul water supply system. It carries water from Otter Lake west to a junction with a 54-inch conduit which conveys pumped water from Centerville Lake¹ (pumping ceased after 1984).

In the 1981 FIS, a stage-frequency plot was developed using 32 years of historic annual high water elevations from 1942-1977 obtained from the Ramsey County Engineer. The measured data is no longer available, but the selected annual maximums are provided in the 1981 report.

The DNR Lake Finder website provided lake level data for a spotty period of record from 1923-2018 (see **Figure 9a**). This data is recorded by Ramsey County in MSL 1912 datum. The County recommends subtracting 0.70 feet from MSL 1912 to convert elevation data to NGVD 29; and subtracting 0.52 feet to convert elevation data to NAVD 88². After converting the Lake Finder lake level data to NGVD 29 datum, the maximum annual lake levels were determined and compared to those found in the 1981 FIS for the common period of record of 1942-1977. The Lake Finder annual maxima were found to be approximately 0.7 foot lower than those listed in the 1981 FIS, suggesting that the 1981 FIS lake levels may have been carried out in MSL 1912 datum. Though the conversion method from MSL 1912 datum to NGVD 29 of subtracting 0.70 feet has been adopted for this study, the conversion method from NGVD 29 datum to NAVD 88 of adding 0.17 feet obtained from VERTCON³ is adopted to be consistent with the other lakes in this study.

The maximum annual series, consisting of 96 data points, was plotted on probability paper, and a polynomial line was fit to determine the elevations for the various recurrence intervals (see **Figure 9b**). The estimated flood elevations are shown in **Table 9a**. The 100-year flood elevation was estimated using the polynomial equation. Insufficient lake level data and information on potential overflow elevations are available to provide a reliable estimate of the 500-year flood elevation.

Both the maximum annual series used in the 1981 FIS analysis and the combined data are plotted on **Figure 9b**. The difference in results shown in **Table 9a**, are the result of both a different maximum annual series (length of data set) and the fact that in the 1981 study, a straight line was fitted through the points, as opposed to the graphically fitted line in this study.

¹ "Final Hydrologic Report, City of Lino Lakes, Anoka County, Minnesota," from May 7, 1980 (prepared by Toltz, King, Duvall, Anderson and Associates)

² Telephone conversation with Al Rupnow, lake biologist with Ramsey County, December 7, 2010.

³ <http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html>

Table 9a: Estimated Flood Elevations for Otter Lake

Return Period	Lake Level Data Source		
	1981 FIS (n = 32)	1981 FIS and DNR (used in this study) (n = 96)	
	(NGVD 29)	(NGVD 29)	(NAVD 88)*
2	--	910.9	911.1
5	--	911.5	911.7
10	912.10	911.6	911.8
50	912.42	912.0	912.1
100	912.55	912.5	912.6
500	912.78	--	--

*0.17 feet is added to NGVD 29 datum to convert to NAVD 88 datum

An additional component of this study consists of creating a non-exceedance frequency graph based on all daily measurements available (see **Figure 9c**). For Otter Lake, the period of record consists of the data found on the MnDNR Lake Finder website, which consists of 2,937 days of measurements, from 1923 to 2018 (see **Figure 9a**). The results are presented in **Table 9b**.

Table 9b: Daily Non-Exceedance Frequency of Lake Levels for Otter Lake

Non-Exceedance Frequency	Lake Level	
	(NGVD 1929)	(NAVD 1988)
2.5%	906.4	906.6
10%	907.4	907.5
25%	908.9	909.1
50%	910.2	910.4
75%	910.8	910.9
90%	911.1	911.3
99.5%	911.8	911.9

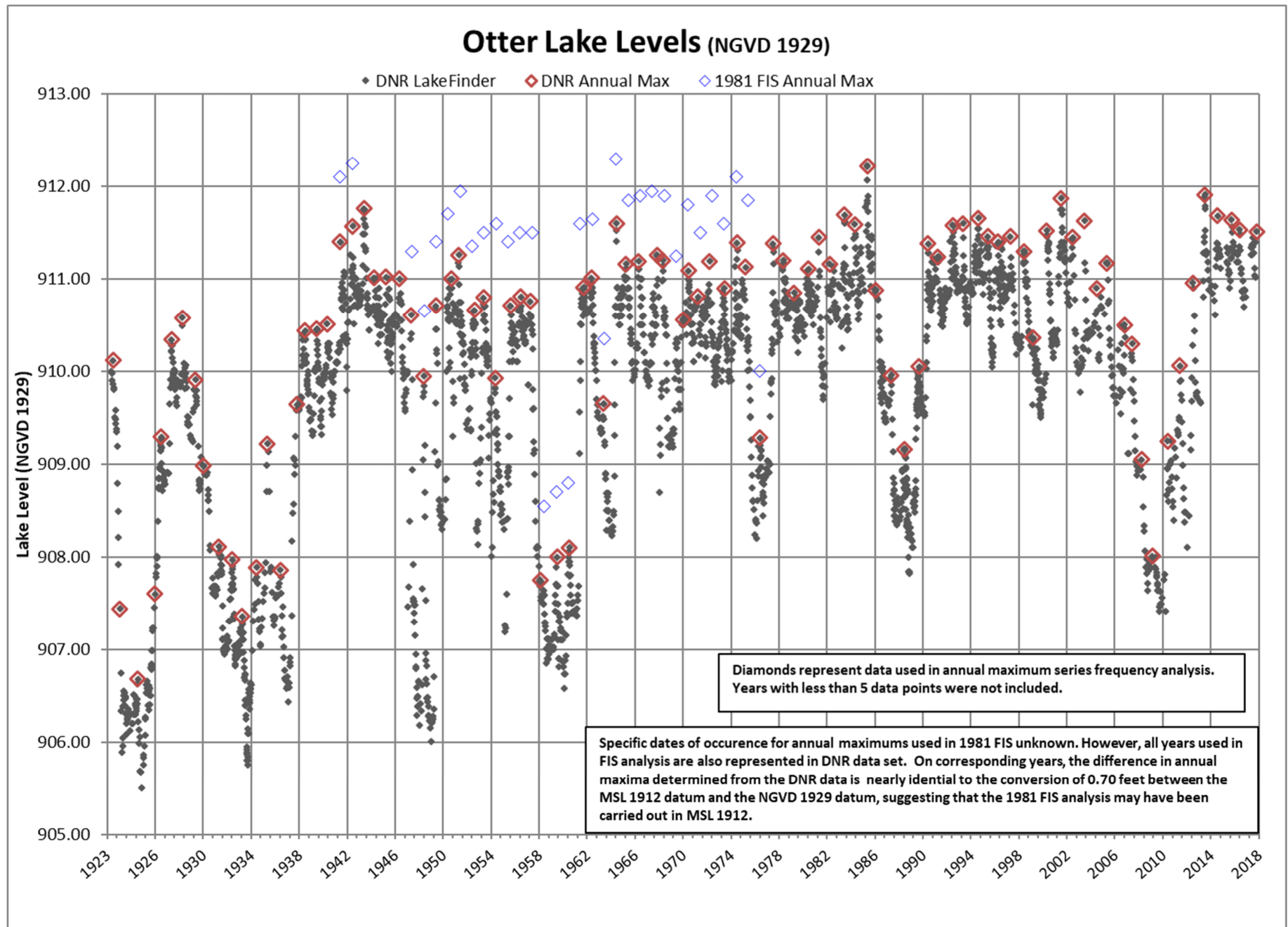
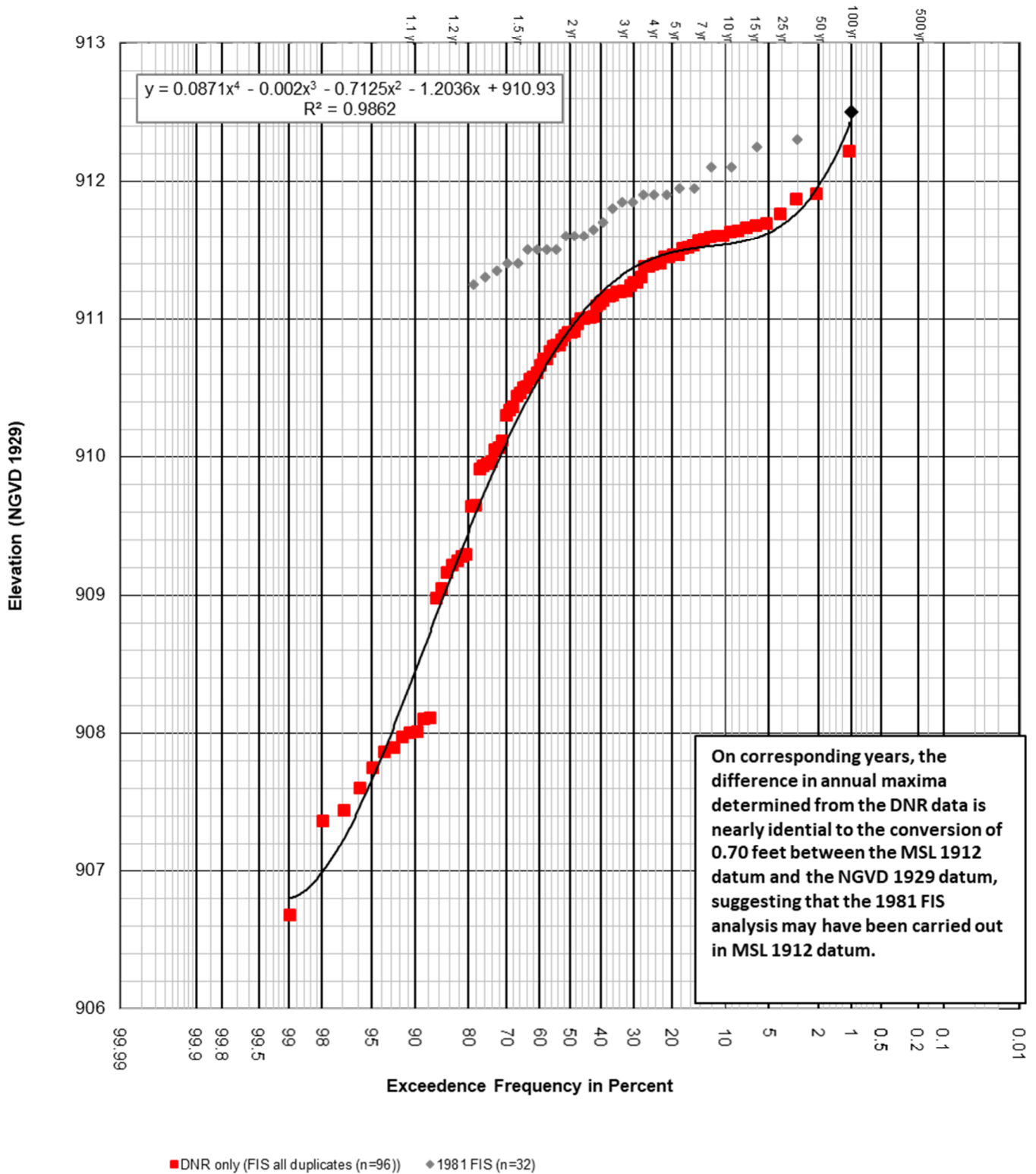


Figure 9a

Otter Lake Levels (NGVD 1929) **Maximum Annual Series Frequency Curve** **(Weibull Plotting Positions)**



Outlet:

2 Lines: 6-ft x 3.5-ft Concrete Box Culvert @ 906.90 (NGVD 29), 907.07 (NAVD 88)

Figure 9b

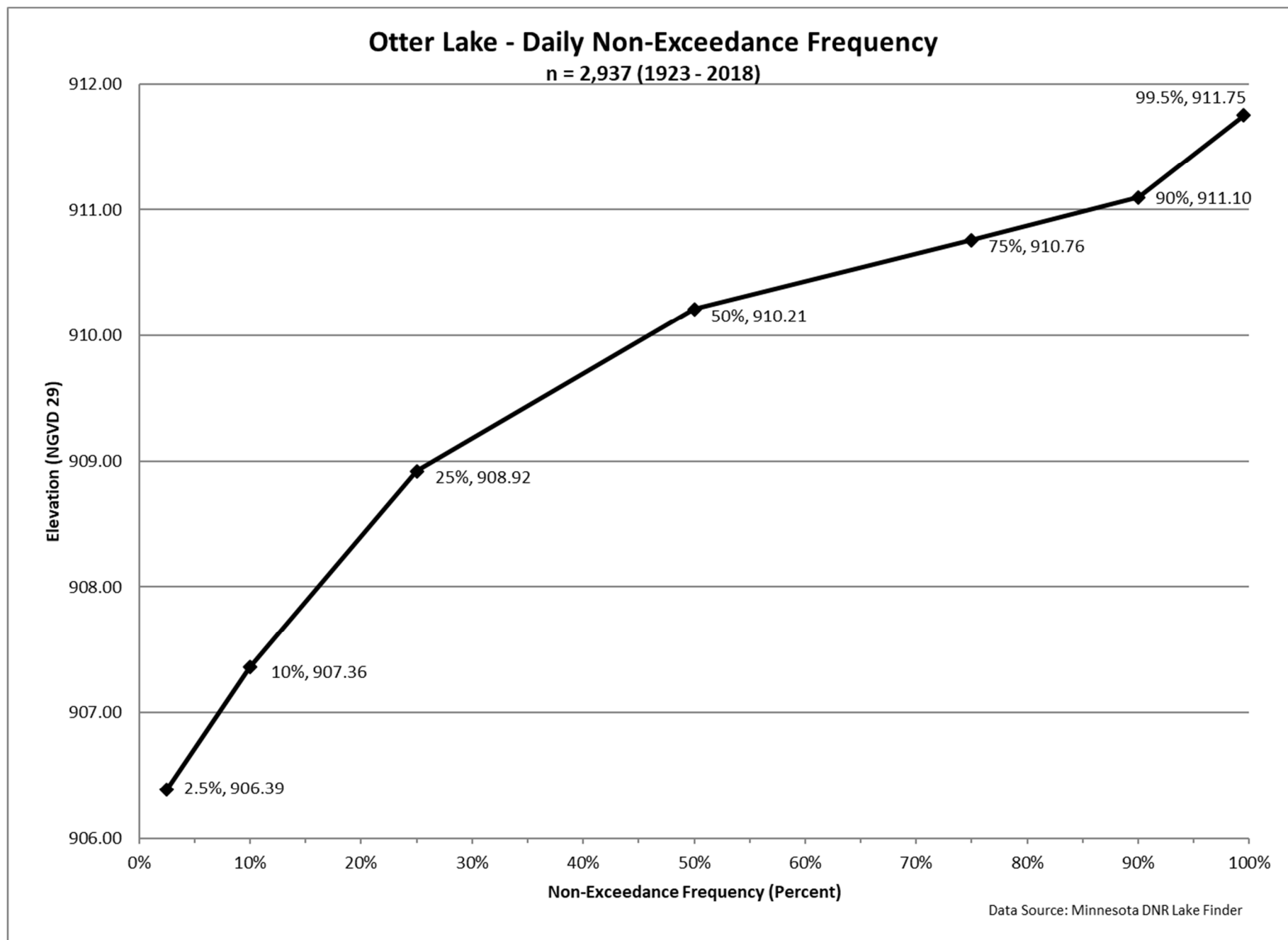


Figure 9c