

# **FLOW TRENDS OF THE PEACE RIVER AT ARCADIA AND THE MYAKKA RIVER NEAR SARASOTA, FLORIDA, AND THEIR IMPLICATION TO FUTURE WATER RESOURCE MANAGEMENT**

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## **ABSTRACT**

Providing high quality, potable water to the world population is becoming increasingly difficult. Projected population growth in Florida is expected to increase significantly in the near future. This growth requires an increase in available water resources. Given the decrease in available groundwater and the resulting impact on stream flow, and that significant new sources of water are not likely to be found, water resource managers must better manage or limit growth; a combination of the two may be the direction of the future. The Southwest Florida Water Management District (SWFWMD) has issued a permit to implement the Peace River Option (PRO). Because the projected water needs of Sarasota County cannot be satisfied locally, SWFWMD has issued a permit for withdrawal and transfer of water from the Peace River at Arcadia, Florida, to the Carlton Reserve Water Treatment Plant near North Port in Sarasota County. However, it has neither been determined whether the Peace River has enough flow to accommodate the permitted withdrawal, nor the impact the withdrawal will have on the Charlotte Harbor estuary. Trend analyses of historical stream flow data for the Peace and Myakka Rivers have shown decreasing flow trends over the last 65 and 60 years, respectively. These two rivers contribute most of the inflow to the Charlotte Harbor estuary. If these trends continue unchecked, significant periods of reduced flow to periods of extended no flow are projected to increase in the future, even without water supply withdrawals. In light of this, a preliminary evaluation of PRO-planned withdrawals was conducted using the historical Peace River stream flow data. This evaluation suggests that the Peace River may not meet the projected needs of the PRO and that the PRO may have to rely on groundwater more than planned to meet the projected demand.

## **INTRODUCTION**

This paper presents the preliminary results of an ongoing study that addresses whether adequate flow exists in the Peace River to support the PRO. Flow trends of the Peace River at Arcadia and the Myakka River near Sarasota, Florida, are presented to support analysis of whether these Florida rivers can sustain significant water withdrawal. Florida's groundwater resources have been seriously depleted from over pumping (Yobbi 1983); because groundwater discharge to rivers is an important component of river flow, river flows have also been impacted. Therefore, rivers may not be viable water supply sources.

The PRO is being implemented between a time of unlimited water resource exploitation and a time when serious water management procedures need to be instituted. Unfortunately, it has not been determined (1)

if enough water is available in the Peace River to meet the projected demand, (2) what impact the projected withdrawal will have on the ecology of the river and the Charlotte Harbor estuary, and (3) which water withdrawal rates and water level criteria should be implemented to ensure that the ecology of the river and the estuary remains viable.

## **THE PEACE RIVER OPTION**

The SWFWMD has issued a permit to implement the PRO. SWFWMD recognizes the need for study of the effects of the withdrawal and has initiated several studies and data collection efforts (Anonymous 1991; Anonymous 1996; SWFWMD 1981). In addition, a number of studies have been performed that indicate the critical nature of Florida's water resources with respect to supplying the current and future needs of its population (Comp 1983; Hammett 1985

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1988, and 1992; Hutchinson 1978; Kaufman 1967; Stewart 1966; Wolansky 1983; Yobbi 1983). An environmental impact study of the PRO was prepared (Savercool 1996) that focused on the impact of the proposed pipeline for transporting water from the Peace River Regional Water Supply Facility to the Carlton Reserve Water Treatment Plant. This study fails to address the PRO's impact on the ecology of the river or the Charlotte Harbor estuary (Dunson 1997).

The PRO permit is difficult to interpret, but it authorizes increases in the annual average, peak month, and maximum daily quantities of water to be withdrawn from the Peace River based on projected growth (see Table 1).

**Table 1.** PRO-permitted withdrawals.

	Million Gallons per day (mgd)	Cubic Feet per second (cfs)
Annual Average	32.7	50.6
Peak Month	38.1	59.0
Maximum Daily	90.0	139.3

Under the PRO, water will be delivered to customers from an aquifer storage and recovery system, as well as from a surface reservoir. Water from the Peace River will be used to replace the water delivered. The permit sets the following conditions under which water can be withdrawn from the Peace River:

- "No diversion from the Peace River may occur when the average daily flow as measured at the Arcadia Station for the previous day was less than 130 cubic feet per second (cfs)."
- "The amount of diversion on the Peace River at District Withdrawal No. 14 shall not exceed 10% of the average daily flow rate of the river as read at the Arcadia Station for the previous day."
- "However, in no case shall the diversion amount exceed the difference between

the previous day measurement at the Arcadia Station and 130 cfs."

These conditions imply that the minimum flow at which withdrawal can occur is 145 cfs (145 cfs times 0.1 equals 14.5 cfs, and 145 cfs minus 14.5 cfs equals 130.5 cfs, which is slightly above the no-diversion limit). Under these conditions, a flow of 506 cfs would be required in the Peace River to replace the average daily delivery of 32.7 mgd. SWFWMD recently implied that a withdrawal of 90.0 mgd rather than 32.7 mgd (Barcelo and Flannery 1997) would be the norm. A withdrawal of 90.0 mgd would require a minimum Peace River flow of 1,393 cfs.

#### **TREND ANALYSIS OF HISTORICAL STREAM FLOW AND PRECIPITATION DATA**

Trend analyses were conducted on historical stream flow and precipitation data acquired for both the Peace River at Arcadia and the Myakka River near Sarasota (Smith and Others 1982; Hamburg 1983). Linear regression trend analyses were conducted using entire records, rather than selecting shorter periods based on anthropogenic occurrences. Short records may not contain enough data to distinguish a trend from the variability in the data (Smith and others 1982). Precipitation data were obtained for stations located in Arcadia and the Myakka River State Park. The primary interest was in the Peace River data, but data from the Myakka River was also analyzed to determine if flow characteristics of the Peace River were regional in nature or river-specific.

Low river flows are supported mainly by groundwater and other discharges, with a small contribution from runoff. Mean and high flows, on the other hand, are mostly the result of runoff, with a small contribution of groundwater and other discharges. Therefore, precipitation is an important contributor to mean and high river flow.

Trend analyses of precipitation data collected at Arcadia from 1932 to 1996 and data collected at the Myakka State Park from 1950 to 1996 were conducted (South Carolina Department of Natural Resources 1997a, 1997b). A decline in precipitation has been reported (Janicki et al. 1997; Shaughnessy 1997). The trend in the Arcadia precipitation data indicates a decline of about 1.1 inches in the annual precipitation over the period of record. This decline is 2.1% of the average annual precipitation and, given the variability of the data, a case could be made that this decline in precipitation is too small to be significant. However, when one considers the volume of water that 1.1 inches of precipitation represents, it is easy to see how a small change in precipitation patterns could greatly impact mean and high river flows that depend on precipitation. Trend analysis of precipitation data from the Myakka River State Park station showed a very slight increase in precipitation over the period of record. While the trend line slope of the Arcadia precipitation data was statistically significant, the trend line slope of the Myakka River State Park precipitation data was not significant, indicating that the slope of the trend line was not significantly different from zero. This suggests that the precipitation amounts in the area of the Myakka River State Park have remained level over the period of record.

The results of trend analyses of high, mean, and low annual flows for the Peace and Myakka Rivers are presented in Figures 1 and 2, respectively (U.S. Geological Survey 1996a and b). The declining trend for the high-flow data is probably directly related to the declining trend for precipitation. The declining trend for the mean-flow data reflects a combination of the declining trends for precipitation and baseflow, while the declining trend for the low-flow data can be attributed to reduced baseflow, as discussed earlier. The high and mean flow in both the

Peace and Myakka Rivers indicates statistically significant declining flow trends, which indicate that this condition is regional in nature, rather than specific to the Peace River, as suggested by Thomsen (1997a, 1997b). Declining trends for high and mean flows of the Myakka River are probably caused by a combination of increased anthropogenic withdrawals and groundwater recharge. The low flow of the Peace River also has a statistically significant declining trend, but the low-flow trend of the Myakka River exhibits an increasing flow trend with a low level of significance.

Declining flow trends are an indicator of a potential problem that can be corrected. However, if left unchecked, declining flows can result in extended periods of significantly reduced flow, extended periods of no flow, and associated implications to the well-being of the river, estuary, and related ecologies.

#### **PRO WITHDRAWAL CRITERIA APPLIED TO HISTORICAL STREAM FLOW DATA**

As discussed earlier, the PRO requires a flow of 506 cfs in the Peace River to meet the average daily demand and a flow of 1,393 cfs to meet the maximum daily demand. No withdrawal can be made from the river if the flow drops below 130 cfs. Trend analyses were conducted of the number of days per year with a flow greater than or equal to 506 cfs over the period of record and of the number of days per year with a flow less than or equal to 130 cfs over the same period (Thomsen 1997b). The analysis indicated that the number of days per year with flow greater than or equal to 506 cfs or 1,393 cfs is decreasing, while the number of days with a flow less than or equal to 130 cfs is increasing. This is to be expected in light of the trend analyses presented earlier and, unless the declines are reversed, indicates that water available for withdrawal by the PRO will decline year after year.

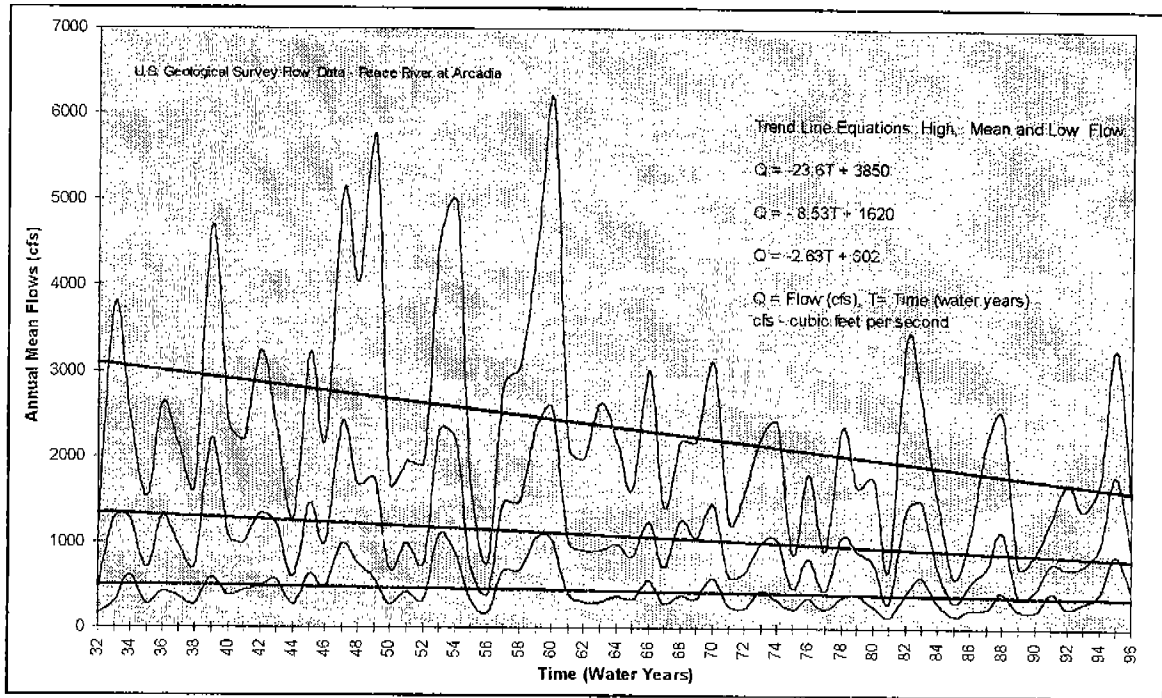


Figure 1. Annual means of high, mean and low flows of the Peace River at Arcadia as a function of time.

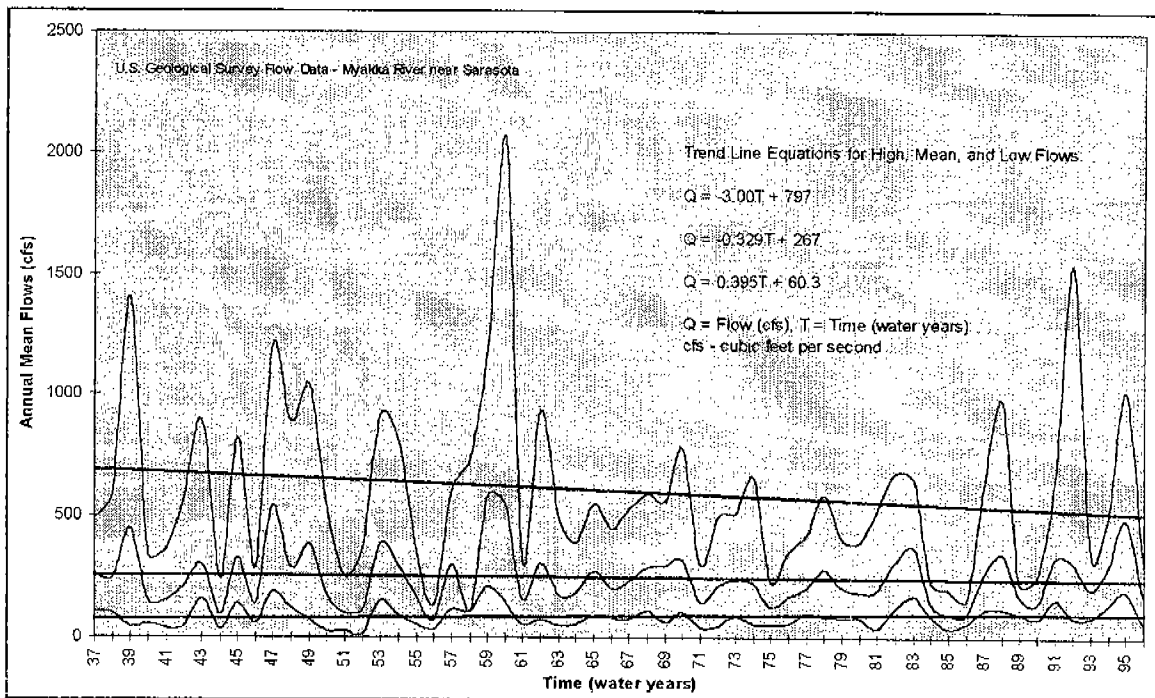


Figure 2. Annual means of high, mean and low flows of the Myakka River near Sarasota as a function of time.

The above indicates that the PRO may not be able to reach its goal of supplying 90 mgd without relying on other sources of water. Can the PRO operate as proposed, even if no declining flow trends exist? To answer this question, the PRO's proposed withdrawal criteria were applied to the Peace River flow data for 1981 (which represents the year having the lowest mean flow) and also to the flow data of 1978 (which has an average annual flow 1 cfs greater than the average flow of the Peace River for the period of record). Figure 3 shows the application of the PRO withdrawal criteria applied to the 1981 flow data. Flow data used was adjusted by eliminating flows less than 145 cfs and using 10% of the remaining values to construct a hydrograph that indicates flow available for withdrawal. Applying PRO withdrawal criteria indicates that 53.7% of the annual average withdrawal required can be withdrawn at the 32.7 mgd rate, while only 19.5% can be withdrawn at the 90.0 mgd rate. The same approach was used on the Peace River flow data for 1978, which represents a period of average flow (see Figure 4). Applying PRO withdrawal criteria indicates that 2.1 times the annual average withdrawal required can be withdrawn at the 32.7 mgd rate, but only 77.2% can be withdrawn at the 90.0 mgd rate.

### **CONCLUSIONS**

The analysis of the preliminary assessment of applying PRO withdrawal criteria to historical data indicates that there may not be enough water available in the Peace River to meet the PRO goal without heavy reliance on groundwater or some other water source to make up the difference. Unless these trends can be stabilized or reversed, this problem will get worse because of the declining flow trends of the Peace River. Further evaluation of the PRO using historical data is needed. Based on the historic flow record, 32.7 mgd can be delivered more than 50% of the time, but 90.0 mgd can be delivered less than 50%

of the time. SWFWMD needs to examine the historical data and determine the percentage of time that their goals of delivering 32.7 and 90.0 mgd can be achieved. With this information in hand, SWFWMD needs to examine the high-flow data to determine whether sufficient flow is available to effectively operate the aquifer storage and recovery system, or it will be necessary to impact other groundwater sources to meet the demand. In addition, SWFWMD needs to make a scientifically sound determination of a withdrawal rate and a minimum water level for the Peace River that will protect the river, estuary, and related ecologies.

The PRO is a typical example of current water resource management practices. The implication of current practices to future water resource management is that readily available sources of water will not meet the future demand. Therefore, either the demand will have to be reduced by limiting population growth, or more sophisticated water resource management needs to be implemented to meet the demand. The introduction of more sophisticated water resource management will support increased population growth to a certain extent but cannot support unlimited growth. Water resources in Florida are limited. Once these resources are exploited as efficiently as possible, a finite amount of water available for use can be determined, and this value can be used for planning purposes.

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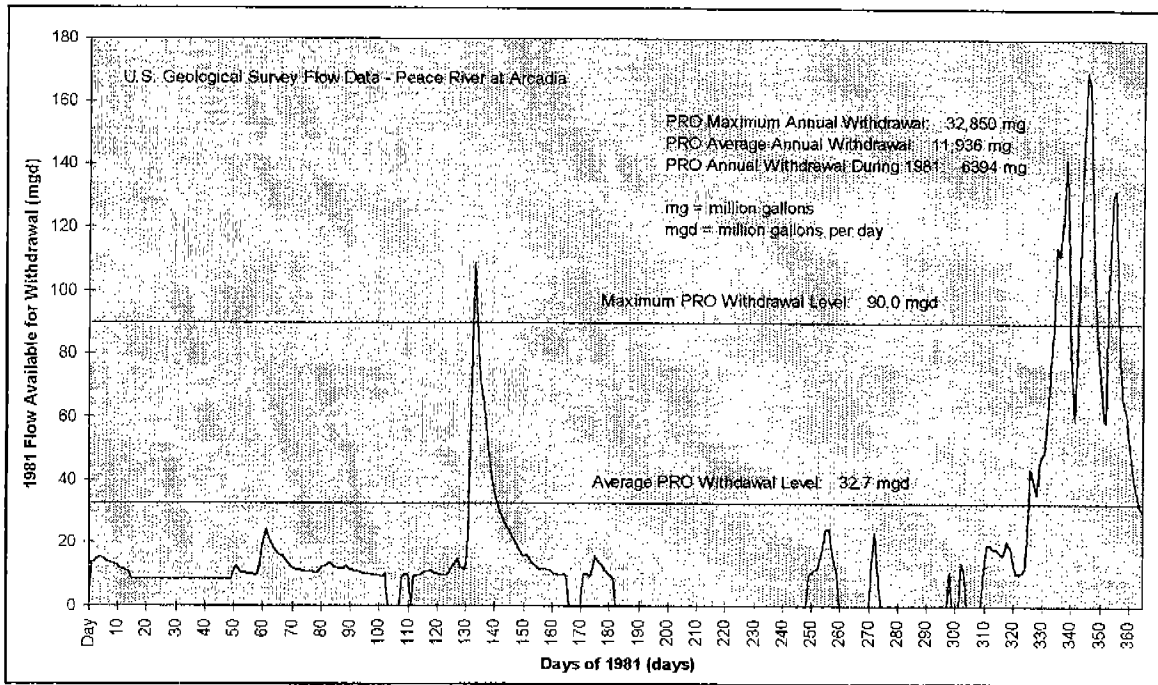


Figure 3. Peace River Option (PRO) withdrawal criteria applied to 1981 (lowest annual flow) Peace River flow data, Arcadia.

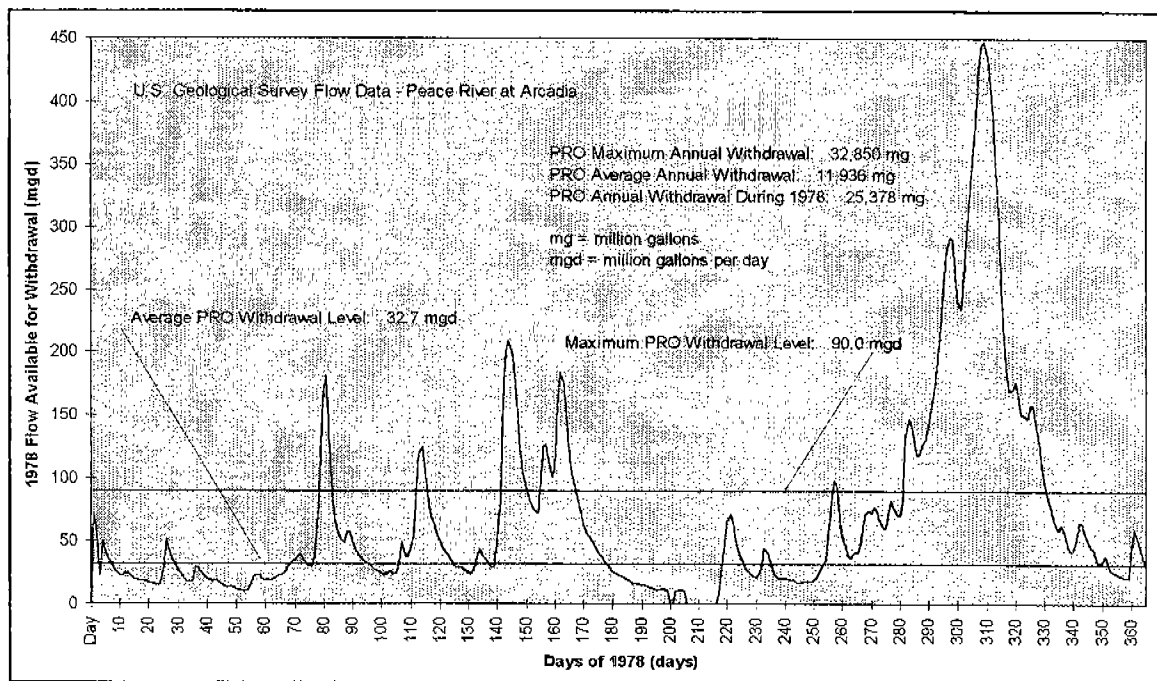


Figure 4. Peace River Option (PRO) withdrawal criteria as applied to 1978 (average annual flow) Peace River flow data, Arcadia.

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