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# INFLUENCE OF LOW, CONSTANT FLOWS ON RIVER RECREATION OF THE COLORADO RIVER THROUGH GRAND CANYON NATIONAL PARK

Jerry M. Mitchell, Resource Management Specialist, National Park Service

ABSTRACT--A study of the influence of low, constant flows on river recreation--specifically, oar-powered, white-water rafting and related trip activities--was conducted during a period influenced by four days of constant, 5000 cfs releases from Glen Canyon Dam into the Colorado River through Grand Canyon. A questionnaire was given to eight experienced white water rafters; this questionnaire was used to assess the influence of this relatively low flow on the character of recreation for each day of travel, for each respondent, during the study period. Some respondents were on the river for the entire period of study while others were only on for a day or more. The results of the survey showed both positive and negative influences. Positive influences appear to be more related to the constant rate of flow: camping beaches are not exposed to rise and fall of water level; there are less problems associated with mooring boats; and the flows are generally described as "better" than fluctuating flows. Negative influences seem to result from the volume of flows: rates of travel are slower, thus effecting itinerary; some rapids are less exciting; rapids are generally more technical (thus also resulting in injuries and equipment damage); and, there is less opportunity for off-river hiking due to time on river.

## INTRODUCTION

During the period of 6 through 9 October 1989, the Glen Canyon Environmental Studies conducted a number of resource related studies along the Colorado River, during a period of low [5000 cubic foot second (cfs)], constant flows from Glen Canyon Dam. These studies were intended to assess several downstream influences of the dam on the resources of Glen Canyon National Recreation Area and Grand Canyon National Park. During this same period, the National Park Service and Grand Canyon River Guides Association conducted a study of the influences of the flow on recreation along the river corridor, within stretches of the river under influence of the constant flow. A total of 8 respondents completed daily questionnaires on the attributes of their schedule and how the flows influenced trip characteristics including: relative difficulty of rapids; itinerary; attraction site visit durations; quality of experience. Only oar-powered boats were allowed on the river at the time of year when the study was conducted.

Glen Canyon Dam, in northern Arizona, regulates the water of the Colorado River through Grand Canyon National Park. Before reaching Grand Canyon, the river runs through a portion of Glen Canyon National Recreation Area, past the area known as Lees Ferry, which is also the put-in for raft trips through the Grand Canyon. Although Lake Powell's primary purpose is water storage, the waters released are also used for hydropower generation. Because the dam is currently used as a peaking power facility, meaning more power is generated when demand and price for electricity is greatest, flows are highly variable. Currently, minimum releases are 1,000 cfs for the period of Labor Day to Easter Sunday and 3,000 cfs for the period Easter Sunday through Labor Day. Maximum flows, unless in flood release, are currently 31,500 cfs. Releases fluctuate within these ranges in response to market demand for electricity (USDI, BOR).

These highly variable fluctuations in flow not only influence downstream natural resources but also have known influences upon recreation. Fluctuations impair an important aspect of the experience for white-water rafters--the naturalness of the setting--and make camping and boat mooring more difficult to manage (Bishop et al., 1987).

Low flows have been attributed to influencing itineraries (Bishop, et al.), since many parties are known to change schedules in order to avoid some rapids during flows believed to be less than 5000 cfs (studies were not conducted under a known and sustained low discharge, in order to verify specific influences). Additional time is often required to scout rapids during periods of low flows.

Flow levels have a significant effect on several accident variables (Brown and Hahn, 1987). For rapids, the accident variables significantly related to flow are: losing control of an oar; striking rocks; flipping a boat; injury; walking passengers around a rapid; and lining or portaging a boat through a rapid. During low flows, striking rocks is more likely because of greater rock exposure.

During the time in which this study was conducted, there was much discussion centering around the need to impose an interim, minimum flow rate for waters released from Glen Canyon Dam. A decision had already been announced that an Environmental Impact Statement would be prepared on the operations of the dam (USDI, Office of Secretary); the interim measures were being called for by some sectors as an immediate means of mitigating influences of the dam until such time as a decision on operations could be made. One of the purposes of this study was to provide data specific to 5000 cfs flows; this was to be used in support of rationale directed to the subject of "interim flows".

The objectives of the study were to assess the influence of low, constant flows (of a known discharge) on the following: the

character of rapids (HØ=Character of rapids under low flows is no different than under higher flows); trip itinerary (HØ=Low flow has no influence on trip itinerary); and, quality of the rafting trip (HØ=Low flow has no influence on experiential quality).

METHODS

Questionnaires were provided to each of 8 trip leaders, through the Grand Canyon River Guides Association. The association contacted each potential respondent after determining which companies had trips on the river during the study period. Respondent were asked to answer the questionnaire for each day of the low flows study period, while they were on the river. If a boatman "put-on" to the river on October 8, for example, two days into the study period, they would complete questionnaires for only 8 and 9 October. If a boatman "put-on" on a day such as October 2 (four days before the study flows began), they would complete their first questionnaire on the first day that constant flows reached them on the river, possibly October 7 for example, and would then continue completing one questionnaire daily until fluctuations in river level resumed.

All responses applied to oar-powered trips, since during that part of the year the river is managed for motorless travel. All responses apply to those portions of the river above river mile 132, since no respondents traveled further during the study period and the rates of flow were much less than were expected. The daily travel distances recorded by the respondents (except one private) are assumed to be approximately the same as would have been traveled under greater flows; the reason being that the commercial trips have an established duration and trip leaders are responsible for keeping the trip on schedule. The amount of on-river time does, however, influence the availability of time for off-river hiking and attraction site visits.

All respondents were already scheduled for the trips on which they reported, eliminating any question on the selection of guides based on their preconceptions. Professional river guides as a group are acknowledged as having "stewards of the river" perspectives of themselves and many admittedly have opinions on how the dam should be operated.

Basic trip information was recorded on each day's questionnaire, for data management purposes. This information included: company and trip leader name; put-in date; length of trip; trip day number and date; river mile from which the group departed morning camp; time of departure from morning camp; river mile at which the group arrived for evening camp; time of arrival at morning camp; total time spent on river; and total river miles covered.

To assess the influence of low, constant flows on the nature of rapids, the respondent was asked to assess which of the rapids were more difficult than at higher flows and which were less difficult

than at higher flows. They were also asked whether they incurred any injuries or damage to equipment; explanations were to be noted for injuries and damage. They were asked whether they had their passengers walk around any of the rapids and if so, which ones.

To assess the influence of flow on trip itineraries, the respondents were asked directly whether such influence actually did occur. If the answer was yes, the respondent was asked to indicate how such influence occurred, by indicating which of the following applied: more time spent scouting rapids; walking people around rapids; dealing with equipment damage; treating injuries; more time and effort spent rowing due to reduced current; or, in other ways--the respondent was provided space for explanation. The respondent was also asked whether they had to shorten their stay at attraction sites, or whether they were unable to stop at any planned stops, as a result of low, constant flows.

To assess the influence of flow on trip (experiential) quality, the respondent was asked how the flows contributed to and/or detracted from the quality of the experience for their passengers (not themselves). They were also given the opportunity to explain any problems or difficulties encountered during the day as a result of low flows.

The study was conducted with a small sample period and small sample size. The responses and results should be considered as trends, and not statistically significant; however, they warrant that the National Park Service take the results into consideration in evaluating variables and supporting positions related to low, constant flow.

## RESULTS AND DISCUSSION

Results apply to oar trips only.

### Influence of Low, Constant Flows on the Nature of Rapids

On 15 of the 25 (60%) response days, respondents listed one or more rapids as more difficult at 5000 cfs flows than at greatler flows Table 1. Of these, Hance Rapid was the most frequently listed, being named by all 5 respondents encountering the rapid during the study period. Waltenburg was listed by all 3 encountering it during the low flow period. Grapevine and Horn Creek were named by 75%, or 3 out of 4, of the respondents who encountered it during the low flow period. Unkar, Nevills, Sockdolager, 24-Mile, Sapphire and Serpentine were all rated more difficult by approximately 60-66% of the respondents encountering them.

## Table 1: Rapids
More Difficult at 5000cfs*

- Named by 100% of Respondents: Hance(5 of 5), Waltenburg(3 of 3)
- Named by 75% of Respondents: Grapevine & Horn Creek (3 of 4)
- Named by 60-66% of Respondent Unkar, Nevills & Sockdolager (3 of 5); 24-Mile, Sapphire & Serpantine (2 of 3)
- Named by 50% of Respondents: Zoraster & 83-Mile (2 of 4)
- Also Named:Kwagunt, Lava Chuar, Nixon,Boucher,112.5-Mile,Bedrock Spector,Dubendorff,Ruby,Badger

(compared to higher flows)

## Table 2: Rapids
Less Difficult at 5000cfs*

- Named by 100% of Respondents: Granite & Crystal (3 of 3)
- Named by 40 % of Respondents: Sockdolager (2 of 5)
- Other Rapids Named: Harding, Tanner, 127-Mile, Grapevine, Nankoweap, All
- Note: Not all respondents encountered all rapids during period

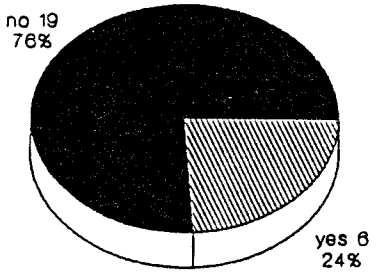
(compared to higher flows)

On 40% of the response days, one or more rapids were identified as less difficult at 5000 cfs than at higher flows (Table 2). Crystal Rapid, one of the more notorious at high flows, and Granite Rapid were both named by all 3 respondents who encountered them during the study period. Sockdolager, which had also been rated by 3 respondents as more difficult, was rated by the remaining two encountering it as less difficult than at greater flows. Grapevine was the only other rapid named in both categories, getting three indications as more difficult and one as less difficult.

On 24% of the response days, respondents incurred equipment damage or had passengers injured while running the rapid (Figure 1). As is listed in Table 3, there were two serious injuries among trip participants; there were three accounts of boat damage and three accounts of oar and paddle damage.

None of the respondents had their passengers walk around any rapids during the study period.

## Figure 1: Injury or Damage
Days: n=25



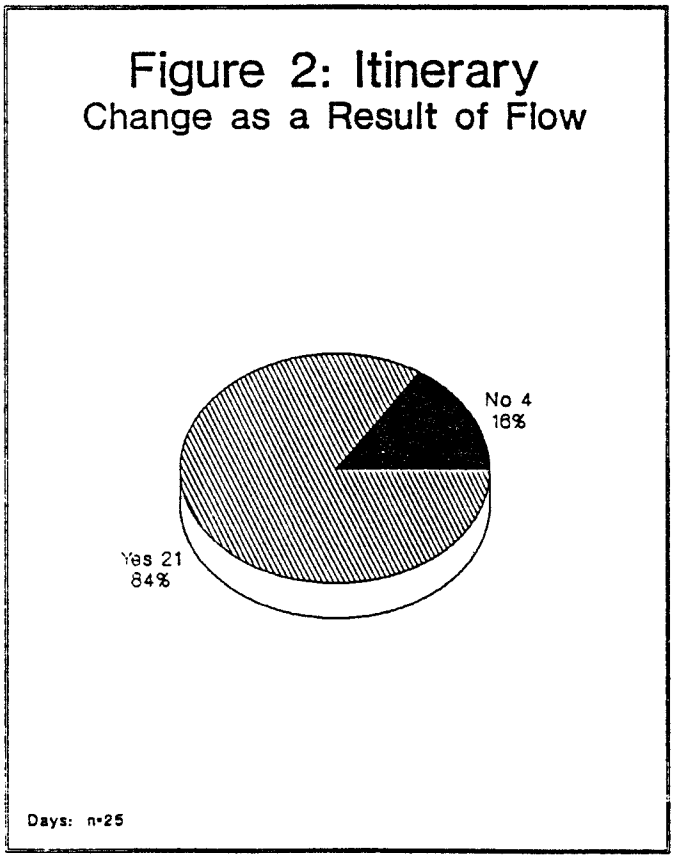

## Table 3: Injury or Damage
List of "yes" explanations

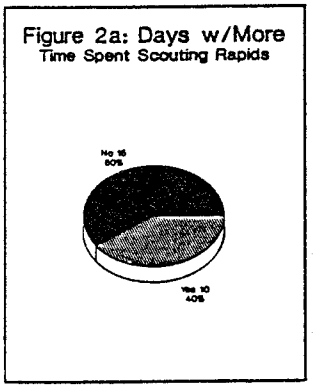
- ripped floor of boat; woman broke foot at Horn Creek
- two oars broken; one paddle broken
- tendonitis from flat water
- head injury at Waltenbury
- rock damage to boat
- rip in floor of raft

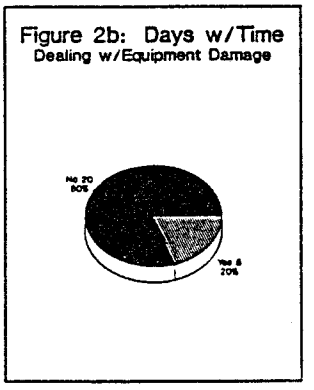
Total of 6 yes responses

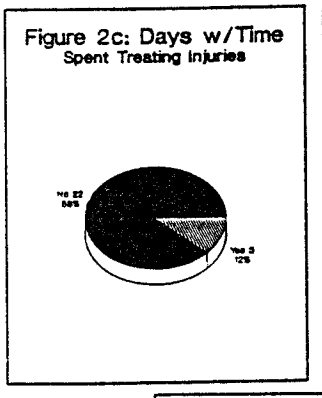
## Influence of Flow on Trip Itineraries

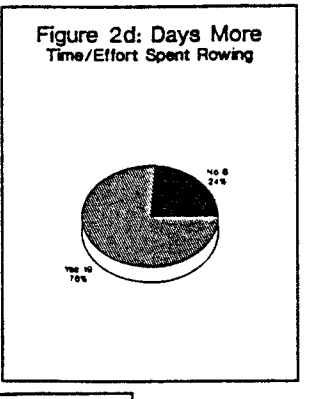
When asked whether low flows interfered with their day's itinerary, respondents answered yes on 84% of the response-days (Figure 2). Since each respondent was allowed to select from any and all of six different possible reasons why their itinerary was effected (as a cumulative influence), pie charts were prepared for each (Figures 2a-e). The greatest influence of low flows on itinerary, noted on 76% of the response days (Figure 2d), is the amount of additional river time required to row in the slow current. Time scouting rapids effected 40% of the response days (Figure 2a), while equipment damage (Figure 2b) and injuries (Figure 2c) meant time spent on 20% and 12% of the response days respectively. Some of the above influences were again repeated by the respondents in the "Other" category (Figure 2e and Table 4), but the explanation listed the most often (on 5 of the 25 response days) related to how increased on-river time cut into or caused to eliminate off-river hiking time.

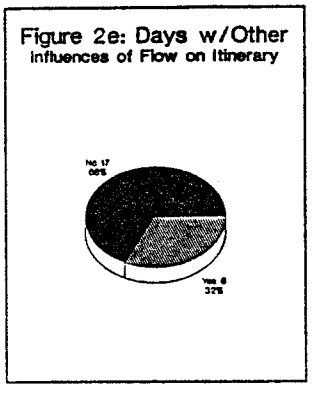


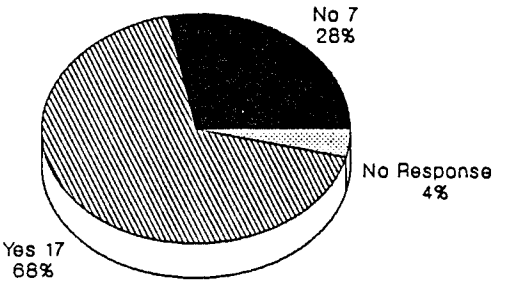



## Table 4: "Other" Responses
### Influences of Flow on Itinerary

- 5 Responses indicated that low flows cut into off-river time, or caused them to have no time for off-river hiking
- 2 responses indicated that flow related injuries, and waiting for helicopter med-evac, caused changes in itinerary
- 1 response indicated that waiting for high water, to do rapids, cut into itinerary

A total of 8 "yes" response days

## Figure 3: Shorten Stay/ Unable to Make Planned Stops




Days: n=25

## Table 5: Reasons-Shorten Stay/Unable To Stop as Planned

- 7 Responses indicated unable to take any planned hikes
- 4 Responses indicated hurried visits, reduced time at stops, or fewer stops
- 1 Response indicated wait to buy time for high water downstream
- 2 Responses indicated injuries/ damage
- 3 Responses with no explanation

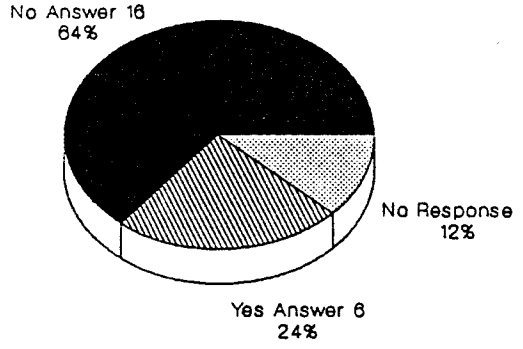
A total of 17 "yes" responses

When asked whether they had to shorten their stay at attraction sites, or whether they were unable to stop at any planned stops, as a result of low, constant flows, on 68% of the response days respondents answered yes (Figure 3). Their explanations (Table 5) again indicate that hiking time was the major trip attribute to be influenced; hikes were eliminated on 7 response days, whereon 4 response days visits were reduced in time or the group was required to take fewer stops.

Influence of Flow on Trip (Experiential) Quality

"Other Problems" were reported on only 24% of the response days (Figure 4). Explanations, which are listed in Table 6, are mostly extensions of impacts related to the slow on-river travel.

## Figure 4: Other Problems Related to Flow




Days: n=25

## Table 6: Other Problems Influences of Flow

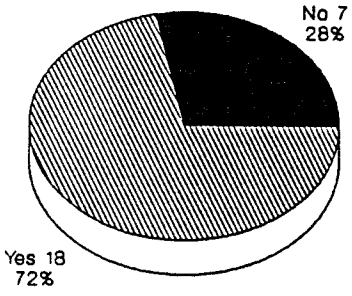
- "Privates going to slow"
- "Late for Phantom Changeover"
- "Winds compound flow problems"
- "Buying time for downriver rapids"
- "row all day to get in hikes"
- no explanation

A total of 6 "yes" responses

On seventy-two percent of the response days, respondents reported that flows detracted from the quality of the experience for their clients/passengers (Figure 5). The explanations (Table 7) indicated that the loss of hiking time, less excitement in running the rapids, a perception that the low flow was an unnatural flow, and the possibilities of client injury, were the main detractors.

The respondents rated many of the rapids more difficult and technical, yet they also indicated on 6 response days that the rapids were less exciting or less fun for their clients under low flow conditions. When asked whether the flows contributed to the quality of the experience, the answer was "yes" on 44% of the response days (Figure 6). As is shown in Table 8, this does not appear to indicate a contradiction. Four of the answers to this question were directed at camping beach conditions (more aerial extent and no inundation by fluctuations). Three indicated that the constant flows were better; this may be an indication that

## Figure 5: Flows Detract
From Quality of Experience



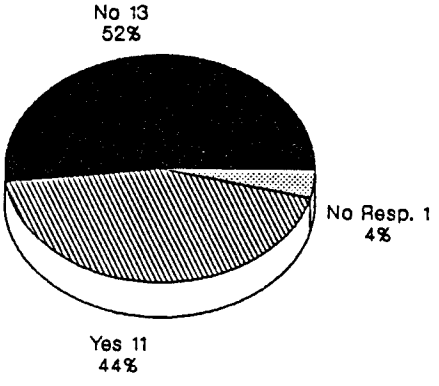

Days: n=25

## Table 7: Detract
From Quality of Experience

- 5 Responses indicated that flow cut into or eliminated hiking time
- 6 Responses indicated rapids were less exciting for clients, small, or less fun
- 1 Response indicated low flows were unnatural
- 1 Response: injury possibilities
- 1 Response indicated current made wind difficult
- 3 unexplained/1 waiting for high

A total of 18 "yes" answers

## Figure 6:Flows Contribute
To Quality of Experience




Days: n=25

## Table 8: Contribute
to Quality of Experience

- 4 Responses indicated that more beach available &/or didn't flood
- 3 Responses simply indicated that constant flows were better
- 1 Response indicated that it was easier to moor boats
- 1 Response indicated that it was easier to float eddies
- 2 Responses indicated better fishing
- Additional comments: clear bottom, clear water

A total of 11 "yes" answers

constant flows are desirable because they seem more natural, as was found by Bishop, but this was not specifically stated in the responses.

## CONCLUSIONS

The data support a conclusion that 5000 cfs flows alter the character of rapids, compared to higher flows. This cannot be said of all rapids, nor can it be said that all rapids become more difficult. It appears generally true that some rapids become more difficult/more technical at low flows while others become less difficult/less technical. Although many trip leaders said they spent more time scouting rapids at lower flows when compared to higher levels, none of the respondents felt it necessary to walk their passengers around the rapid because of any perception of potential safety concerns.

The data also support a conclusion that 5000 cfs flows influence normal, planned oar trip itineraries. The greatest reason for the influence is the amount of on-river travel time, although scouting rapids, dealing with injuries and equipment damage, and having to eliminate or shorten other trip activities are also significant changes to planned itineraries.

Attraction site visits and side-canyon hikes are major trip attributes for many visitors and the data support the conclusion that these activities were either eliminated or shortened as a result of rate of on-river travel, on a significant number of trip days.

The low, constant flows can also be said to have some positive and negative influences on experiential quality. The positive influences generally relate to the constant nature of the flows. The most commonly given benefits related to camping beaches. The low flows made more aerial extent available for camping. The constant nature of flows made camp and boat management easier: camping beaches did not flood with the rise and fall of waters and boats did not require re-mooring during the night or placement back in the water before departure. Although no respondent actually said the flows were more natural, they did characterize the flows as better.

The negatives associated with low, constant flows generally relate to slow current and its effect upon rate of oar travel. More on-river time was spent, due to the slow current. This in itself might not be such a great negative if it did not cut into off-river hiking and attraction site visiting time. Since almost all of the respondents represented commercial outfitters, trying to keep on an established schedule, the element of the trip to be cut into or eliminated was hiking time or attraction site visits--since on-river time had to be made in order to stay on established

schedules. The one private group trip leader among the respondents indicated a willingness to wait until there were higher flows before going downstream--possibly because of the difficulty of certain rapids or reaches of the river. He also indicated in his responses that these delays were beginning to cut into planned attraction site visits and hikes downstream.

Still on the subject of experiential quality, but relating the subject of the character of rapids, is the evident that low, constant flows make rapids less exciting for commercial clients/passengers, yet more difficult, or technical, for the boatman. The exciting rapids of the Colorado River are the major draw for many visitors to the Colorado River through Grand Canyon National Park.

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Bob Melville and Rob Elliot, of Grand Canyon River Guides Association (GCRGA), took our list of questions and coordinated preparation and distribution of the questionnaire. The following guides (and GCRGA members) completed the questionnaires and faithfully returned them to us: Garrett Schniewind, of Canyon Explorations; Tony Anderson, of Oars; Les Hibbert, of Diamond; Geoff Behan, of Expeditions Inc.; Doug Stanley, of Outdoors Unlimited; Richard Erdman, private; Michael Jacobs, of Moki Mac; and Walt Gregg, of Sleight.

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DAILY LOG OCTOBER 6 - 9, 1989 GCRG LOW FLOW SURVEY

Company_____Trip Leader_____

Put-in date_____Length of trip_____Trip day #____Date_____

Departed morning camp, river mile_____at _____(AM / PM).

Arrived evening camp, river mile _____at _____(AM / PM).

Total time spent on river_____River miles covered_____

Please use back of sheet for any further explanations.

1. Which rapids were more difficult than at higher flows? _____, _____, _____; less difficult?_____, _____.

2. Did you have any injuries or damage to equipment due to low flows? ( yes / no ) If yes, please explain. _____
_____

3. Did you have your passengers walk around any rapids?(yes/no) If yes, which ones?_____

4. Did low flows interfere with your day's itinerary? (yes/no) If yes, circle the ways:
   A. more time spent scouting rapids.
   B. walking people around rapids.
   C. dealing with equipment damage.
   D. treating injuries.
   E. more time and effort spent rowing due to reduced current.
   F. other ways:_____
   _____

5. Did you have to shorten your stay or were you unable to make any planned stops at attraction sites because of low flows? (yes/no) If yes, please explain. _____
_____

6. Other problems or difficulties encountered today due to low flows, not covered by the above questions. _____
_____

7. Did the low flows significantly detract from the quality of the experience for your passengers? (yes/no) If yes, explain.
_____
_____

8. Did the low flows contribute to the quality of your trip in any way? (yes/no) If yes, please explain. _____
_____
_____