Guidelines for Resampling from Marsh Stations

Introduction

Marsh water quality monitoring projects are designed to collect data from specific stations at a particular frequency, usually monthly or biweekly. Data from a subset of these stations are used to calculate compliance with State of Florida TP (Total Phosphorus) Rule and the 1991 Settlement Agreement LNWR Marsh Phosphorus Levels. As written, the compliance tests mandate monthly sampling from each station although the test may function with more or less data. This document briefly outlines the theoretical causes that generate "excess", including resampling of stations and suggests guidelines for when and if such resampling is appropriate.

Multiple Causes for Sample Resampling

Reasons for resampling can be divided into four categories: 1) Project Logistics, 2) Sample Collection Failure, 3) Laboratory Failure, and 4) Result Validation. Each of these categories is discussed in detail below.

1) Project Logistics and Overlapping Monitoring Designs

Logistical issues within a project may lead to the collection of data that may be interpreted as a resample whether they actually are or not. Frequency of sample collection within a given month is determined in response to multiple mandates, some with different required frequencies; consequently, sampling frequency to meet all mandates can often be different than that required by a specific mandate. Additionally, a station can also be perceived as having been resampled when the number of stations required to be sampled on a given day to satisfy multiple mandates, exceeds the capacity of the sampling crew. This may lead to overlapping stations having several independent samples collected on different days for multiple projects. Addressing the resampling issue that arises through project logistics can be done through optimization of sampling stations.

2) Laboratory Failure

Following the delivery of a sample to the laboratory, a variety of circumstances can result in a sample being lost and can include bottle breakage, spills, exceeding holding times or improper processing. Similar to Sample Collection Failure, the result is that the sample is not available to be analyzed or the analytical process has been compromised. Fundamentally however, the two differ in the amount of time that passes before a sample has been identified as "lost". Unlike the narrow temporal window (hours) during sampling in which a sample can be deemed lost, hours to days to weeks may mark the difference between a sample arriving at the laboratory and it being identified as lost. Because of the time sensitive nature of collection and the possibility of changes in the ambient environmental conditions at a station in response to an extreme weather event especially during the wet season, it is not probable that a station can be resampled in a timely manner. Although staff may request that a station be resampled when the original has been lost to Laboratory Failure, such a request is very unlikely to be timely or cost effective and will not be considered further in this document.

3) Sample Collection Failure

The successful collection of data and/or samples in the field can be influenced by a variety of circumstances, such as equipment failures, adverse weather conditions, human error and/or other factors. Often these "lost" samples are the result of a variety problems associated with the sampling, including failure to collect a sample, failure to properly process and/or preserve a collected sample, bottle breakage, transportation issues that either damage samples or delay them beyond holding times, or a combination of any of these. Regardless of the cause, the result is that the sample is not available to be analyzed; subsequently, the SFWMD project manager may request that a second sample be collected from the station(s). Station resampling may be defensible as long as the second sample is collected in a timely manner and before any event that might significantly alter ambient conditions. However, to date no guidance on how quickly such a sample must be taken or which ambient conditions are of concern. This document will serve to establish guidance in this area.

4) Result Validation

Following the successful collection and analysis of a sample, the analytical result may appear to be a historical outlier. In this example the sample, which has passed all field and laboratory quality controls, yields a value so far outside the expected range of values that the project manager (or another, acting in an official capacity) deems it a valid outlier using all available information and subsequently requests that the station be resampled to validate the original. This decision is wrought with potential problems. First, the time difference between the collection of a sample and the analytical results being presented to the project manager may be separated by weeks or months. Similar to resampling to replace a sample lost through Laboratory Failure, our ability to resample a station for an aberrant result is usually precluded by temporal constraints. Second, data that are shown to be real outliers may necessitate additional investigation and research to address why the sample value was so different.

Factors Influencing Guidelines for Resampling

When contemplating recollection, one must also take into account the parameter of interest and its priority within the mandate, permit, and/or compliance requirement. Not all parameters have the same priority. Although some parameters have regulatory significance (Class III Standards) they are not subject to monthly compliance testing. Thus, the resampling policy outlined herein follows the logical dictate that TP, which is the most important compliance parameter, is the parameter around which a second sample decision should be developed. Consequently, the following three factors were considered in formulating the guidelines for determining if a second sample is needed:

1. Total clear water depth influences the applicability of compliance tests and dictates which parameters are collected at any station therefore; total water depth needs to be included in the decision matrix with TP.

2. There is no requirement for TP Rule stations in a particular network to be sampled on the same day therefore; sampling trips should be scheduled in such a way that eliminates duplicate samplings of the same station.

3. Beyond any legally mandated requirements, there is significant logistical and interpretive value in minimizing the time between sampling different stations in the same waterbody, therefore; stations from a single water body should be sampled in the shortest possible time frame, preferably within the same day when safe and practical.

Guidelines for Project Logistics

As described above, logistical issues may generate, or appear to generate, duplicate samples. To eliminate or minimize this issue, the following recommendations are made:

1. All projects should be optimized in terms of station number, location, and sample frequency to eliminate duplicative work if possible.

2. Samples that are collected under the auspices of multiple projects, mandates, permits, etc. must be collected using approved and standardized collection and data validation methods consistent with the State QA Rule (62-160, F.A.C.) .

General Guidelines for Laboratory and Sampling Failures

The following are general guidelines intended to be used when either laboratory and/or sampling failures are encountered:

1. A station may only be resampled if the lost sample is a TP sample or if the measurement of total clear water depth was done improperly.

2. Resampling requires that all parameters associated with the original collection at the station(s) in question will be re-collected.

3. Sampling staff and the Field Project Manager are required to assure that the field notes and sample comments clearly record that resampling has occurred.

4. Resampling will be scheduled on already existing sampling trips: no flights should be scheduled specific to a resampling effort.

Resampling Guidelines for Laboratory Failures

Overall, the number of lost samples generated as a result of laboratory failures should be extremely low. Consequently, such failures should have little impact on compliance testing and therefore should not be a cause of concern. Additionally, because laboratory failures are unlikely to be detected within two days of the original event, lost time-sensitive samples resulting from a laboratory failure can not be resampled and thus no second sample should be collected. While non-time-sensitive samples lost to laboratory failures have the potential to be resampled, this course of action is not recommended except under the unusual circumstance that the failure is discovered within two days of the original sampling. If this occurs the rules for sampling failure resampling should be invoked.

Resampling Guidelines for Sample Collection Failures

To eliminate or minimize problems associated with collecting a second sample to replace a sample deemed lost because of sampling failures, the following recommendations are made:

1. The nature of sampling is such that if failures occur, they may occur in singular or systematic manners, compromising individual, multiple or even all samples. Consequently, a threshold value of lost samples must be considered. As a guideline, a sampling event which suffers failures which amount to at least 25% of the samples required for the monthly compliance test for a specific waterbody, should be considered compromised and require mandatory resampling at all stations at which samples have been lost.

2. If the total number of lost samples is <25% of the total monthly samples needed for the compliance calculation, a mandatory resampling is not required. If a resample is requested, it must be justified in writing and approved by the supervisor of the Field Project Manager making the request.

3. If the compliance test is not time or stage sensitive (such as the TP Rule), resampling may be scheduled for any other regularly scheduled sampling trip within that month unless ambient conditions have so obviously changed (e.g. a storm event occurs between the initial and second sampling event) that replacement samples can not be collected.

4. If the compliance test is time or stage sensitive (such as the WCA-1 portion of the Settlement Agreement) resampling may only be scheduled for any regularly scheduled sampling trip within two days of the original event.

The 25% Resampling Threshold Value

The TP Rule mandates monthly monitoring but the rule can still function if an individual station has only six data points as long as at least one data point is in both the wet or dry season. This means that the rule only needs 50% of the data it actually mandates. Using the guidance provided here would allow for an acceptable loss of approximately 20% of the mandated data and still provided a sufficient buffer for data losses to environmental conditions such as low water.

The Two Day Rule

This rule was developed specifically to meet field logistics issues. Essentially, sampling via helicopter is done from Monday to Wednesday. Any time/stage sensitive sampling (WCA1) failures that occur on Monday can be detected that same day and potentially be scheduled for resampling either Tuesday or Wednesday. Since helicopter sampling is rarely scheduled for Thursday or Friday, the possibility of resampling on these days is low. Therefore, the two day rule serves to guide staff to restructure trip schedules to accommodate potential resampling events.

Additional Comments

1. Introduction section: We do not believe that there is ever any statistical disadvantage to having added information. Although added information may complicate some statistical evaluations, this complication should not stand in the way of additional data collection when needed. We suggest deleting the sentence ~~Consequently, the existence of more frequent data, whether collected routinely or in response to unplanned events, creates difficulties in both the application and interpretation of compliance tests.~~

   Response
   While we agree that there is no statistical disadvantage to having more data, the issue raised here is not statistical but rather a functional one. TOC members and District employees themselves have raised concerns over how to handle data created in excess of the compliance need. While some protocols are in place, there remain problems generated when the data available exceeds the compliance test design.

2. We suggest the following change in the first paragraph.
   This document briefly outlines the theoretical causes ~~which may result in the collection of a second sample from a station~~ missing or lost samples, and ~~suggests~~ establishes guidelines for when and if such a replacement sample collection (re-collection) should or should not be attempted ~~considered~~.

   Response
   District staff does not agree with the text change in its entirety but will work to revise the paragraph in question.

3. Multiple Causes section #3: When you read the document in its entirety, does this section mean that the entire network would be re-collected if one bottle is past its holding time? If so, this guidance should lay out a mechanism by which SFWMD official is available and immediately notified to make decision on those sample collection/processing dates.

   Response
   The intent of this section is not to supply guidance but rather to explain how laboratory failures contribute to the issue. No guidance is inherent in this section. As stated it is improbable that a laboratory failure could trigger a timely recollection, this is particularly applicable to holding time issues.

4. Multiple Causes section #4: Why is the time lag described as weeks or months? We have been told that EVPA samples are processed for TP within 5 days of collection.

Response
While this document is highly relevant to the compliance tests carried out using EVPA data, it also applies to data collected under the TP Rule, which is not necessarily run within 5 days of collection. Additionally, the intent of this section is to explain how laboratory failures contribute to the issue, and at this stage in the document no guidance focusing just on TP has been suggested.

5. Multiple Causes section #4: Is the title "project manager" well defined at the SFWMD? If possible, please more clearly define "project manager" and "another, acting in an official capacity."

   Response
   The intent of this section is not to supply guidance but rather to explain how result validation could contribute to the issue. As a summary of the issue, the terms "project manager" and "another, acting in an official capacity" are used generally to acknowledge that specificity must be established in the actual guidelines later, although the term "Field Project Manager" is already well defined by the District.

6. Multiple Causes section #4: Last sentence seems indecisive. Research into causes for elevated TP in the Refuge is, we believe, mandated under the Consent Decree. Gaining a better understanding of causes of anomalous measurements is in the interest of all parties and is a part of good QA/QC. Whether categorized as research, monitoring, or QA/QC, any needed field work to better understand causes of outliers is well-justified. We do understand that there may be practical and logistical constraints to such examination.

   Response
   We agree that understanding the causes of anomalous measurements is in the interest of all parties. However, if anomalous results are routinely generated by conditions that cannot be discerned in the monitoring data itself, a research project focused on the issue and related processes should be initiated.

7. Recollection Guidelines Project Logistics #1: Does this mean that the SFWMD is interested in optimizing (reducing) compliance network stations?

   Response
   The District is in favor of optimizing all monitoring programs, and has an active program for this. However, the District does not agree that optimization means reducing the number of stations. In the context discussed here, the District is intent on optimizing sample collection by reducing the number of redundant station visits. For example, in WCA-2A station F1 is required to be sampled under the EVPA program (biweekly), the TP Rule (monthly), and the Threshold program (monthly). However, since there was initially no coordination between

these programs, the potential existed for this station to be visited four times within a single month, when a coordinated biweekly collection would suffice.

8. Recollection Guidelines Sample Collection Failures #2: It would also be helpful to provide a better rationale for the 25% threshold. Is there a statistical justification for the 25% value?

   Response
   The 25% number was not derived statistically, but rather based on the minimum number of samples needed to meet the requirements of the TP Rule. For example, WCA2A has 16 TP Rule compliance stations sampled monthly, which potentially generate 192 values. However, the minimum requirement for a station to be included in the annual assessment is not 12 samples, but 6 (with at least 1 sample in the dry season). Based on this rule, 50% of the samples at a station can be missed and still meet the compliance needs. Staff derived a failure to collect less than 25% of needed samples (WCA1 <6, WCA2A<4, and WCA3<5) as reasonably protective of meeting this need.

9. Recollection Guidelines Sample Collection Failures #3: The requirement that the request must be "justified in writing and approved by the supervisor of the Field Project Manager making the request" seems overly officious and unnecessary. We feel it should be deleted.

   Response
   Disagree. The subject requirement as described is under this policy for the non-mandatory resampling when sample collection failure is less than 25%. As such it is a judgment that requires significant allocation of resources that must be approved.

10. Recollection Guidelines Sample Collection Failures #5: recollection within 2-days. Is there a mechanism in place to make this happen? We know of none.

    Response
    This issue has two components. The first component is can we rapidly determine that a field sampling error has occurred? The answer to this is yes, we can determine within the same day if field sampling errors have occurred when samples are delivered to the laboratory, often within hours of sample collection. The second component is can we respond and add the required station to an already existing sampling trip. The answer to this is also yes, electronic documents can be readily modified to add additional stations as needed. The fundamental issue is the existence of a regularly scheduled trip. If no helicopter trip is scheduled after the stage sensitive trip, then resampling within two days is unlikely. However, if sampling trips are properly managed, this requirement could be easily met.