# Drogue Study for Dyes Inlet
# Sampling Plan

## Prepared by:

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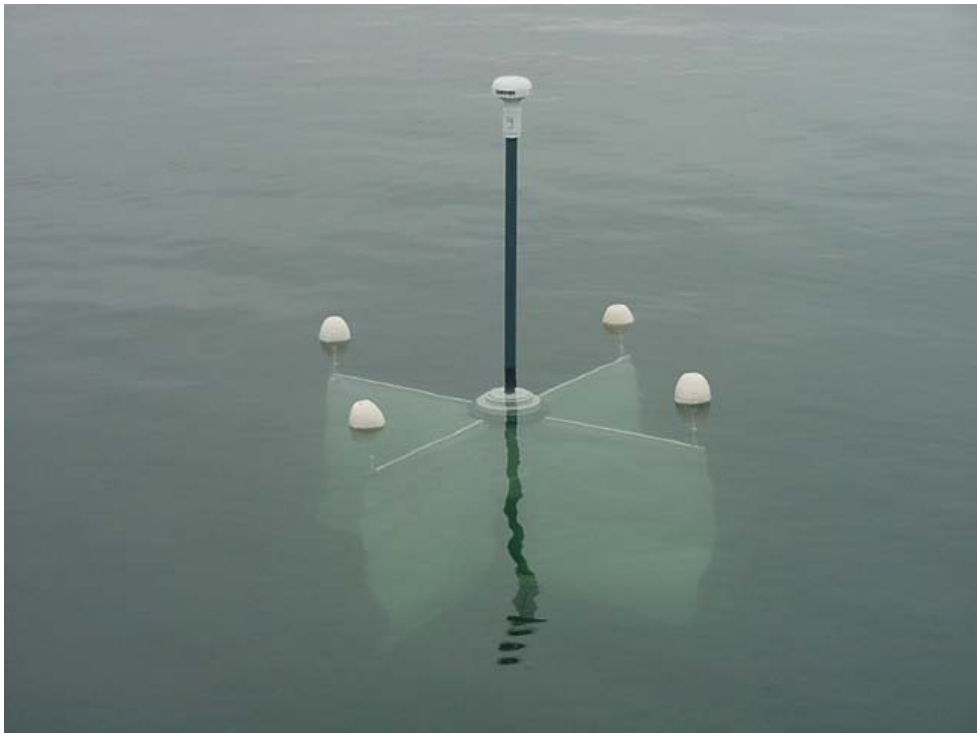


*September 20, 2000*

# DRAFT RECOMMENDATIONS TO CONDUCT A DROGUE STUDY IN DYES INLET,

As part of
THE MODEL APPLICATION TO ASSESS CSO IMPACT ON SHELLFISH BEDS IN DYES INLET, WA

Frank Meriwether
DOH Food Safety and Shellfish Program
September 11, 2000

## I. PURPOSE

The purpose of a drogue study in Dyes Inlet is to 1) collect data that describe transport patterns in Dyes Inlet under the specific tidal conditions, and 2) provide data for model confirmation of CH3D, the CSO fate and transport model to be developed for the study . Results from the drogue study would be used in a post-calibration phase to confirm model results. Drogue study results are part of Tasks 8 (Collection of Field Data) and 10 (Model Confirmation with Field Data) within the Scope of Work proposed by CTC for the Navy. The drogue study will focus on the transport of waters originated from the Port Washington Narrows where the CSOs are discharged. The study will concentrate on recording trajectories of drogues released during different flooding tidal conditions, and dispersed towards intertidal shellfish beds identified by the Suquamish Tribe as beds of commercial interest.

## II. METHODOLOGY

### A. Timing of the Study

Three series of drogue releases are anticipated for the drogue study. The first series of drogue releases will be located across the mouth of the Port Washington Narrows at Windy Point. The results of this series will be used to define the location of the next two series of drogue releases. (It will be difficult to use results of the first series of drogue study to plan for the next two release studies. Such planning (e.g., selection of the three release sites) should be conducted before these three release studies. For this, we can use CH3D to understand the general flow patterns and select potential strategic locations for the drogue studies in Dyes Inlet.) At this time it is assumed by DOH that a subsequent series of drogue releases could occur somewhere in the central portion of Dyes Inlet, and another series within Ostrich Bay. The three series of releases should occur within a brief time span, in order to reduce any hydrographic changes that can occur with time. At this time the first series of drogue releases is scheduled for October 13$^{th}$, and the second series is scheduled for October 20$^{th}$. The third series may be during the time period of October 23rd-25th. (What is our strategy here? Tides in Oct. 13 will be close to neap tides, so are the tides for Oct. 23-25. Oct 20 is just past Spring tides. If we want to capture

maximum tidal forcing (and hence maximum tidal currents), then Oct 16-17 is the right time. Do we want to select three different tidal conditions: 1 maximum, and 2 medium tidal forcing for the three studies? For all 3 release studies, we want to capture the strongest flooding tides, which is about 3 hours after low slack tides. How do we remove the effect of wind? We should analyze wind data to understand the wind patterns. If possible, we want to have least wind during the release/transport studies. But we still would need to get the wind data during the rlease studies.

B. Methodology of a Series of Drogue Releases
(The following two discussions should be included here: 1) Previous Drogue Studies, and 2) More detailed descriptions of the current study. Discussions should concentrate on the validity of drogue study, since controversies exist on the validity of using drogue studies to describe water motions. Discussions should include characteristics (e.g., dimension, density and materials) of the drogues to be used and why drogues are good indicators of motions of water particles. Issues regarding drogues include: relative motions to ambient flows (inertia effects, added mass, …), chaotic behaviors, …. (REF…) For designs and plans for the present study, these issues need to be discussed before the release plan.)

For the purpose of this study it will be assumed that the CSO discharges rise or remain close to the water surface and are not mixed uniformly in the water column. It is therefore recommended that a set of five "shallow" drogues be deployed simultaneously during each release. The vanes of these shallow drogues are to be set at two feet below the water surface.

The initial set of five drogues is to be released one hour after low slack tide, the second set one hour later, and the third and last set three hours after low slack tide. If possible, the ends of the transect of the drogue release points should be identified by a visible mooring buoy or float. A minimum of three boats will be required to track the drogues, monitor and record their individual positions using GPS units. All watches should be synchronized. All boats should be in radio contact with each other throughout their time on the water. It is anticipated that, once the drogues are beginning to disperse, each boat will have an area of coverage to track the drogues. Each set of drogues will have floats or ribbons of a different color in order to distinguish and identify drogues. In addition the float of each drogue will be marked with a unique number for monitoring purposes.

In order to monitor the location of a drogue, the boat crew should not interfere with the course of the drogue, but if possible should approach the drogue alongside, ten yards or more away. (Ten yards may be still within the wake of the boats. Important thing is the boats should always stay in parallel to the flows, not obstructing the flow.) The coordinates are to be recorded on waterproof paper in lat/longs (in the same units), along with the time of reading and any pertinent comments. A set of paper for this purpose will be distributed to all boat crews before the study. Copies of a good map of the area will also be given to each boat, indicating the initial release points, and to help the crew mark the general location of individual drogues that are becoming widely dispersed. Boats should actively roam their area taking continuous recordings of the drogues after they

become dispersed, especially the drogues that are moving rapidly. Each boat should also carry a refractometer and occasionally measure surface salinities. The salinity reading taken next to a drogue should be recorded with the drogue's location. (We should think about putting 1-2 ADCP in Dyes Inlet, covering the time periods for the three release studies. ADCP can take data for over 1 month.)

If a drogue becomes grounded, the boat crew should record it. Then the crew should try to retrieve the float and move it out (perpendicular to shore) to slightly deeper water and release it, recording the time of retrieval.

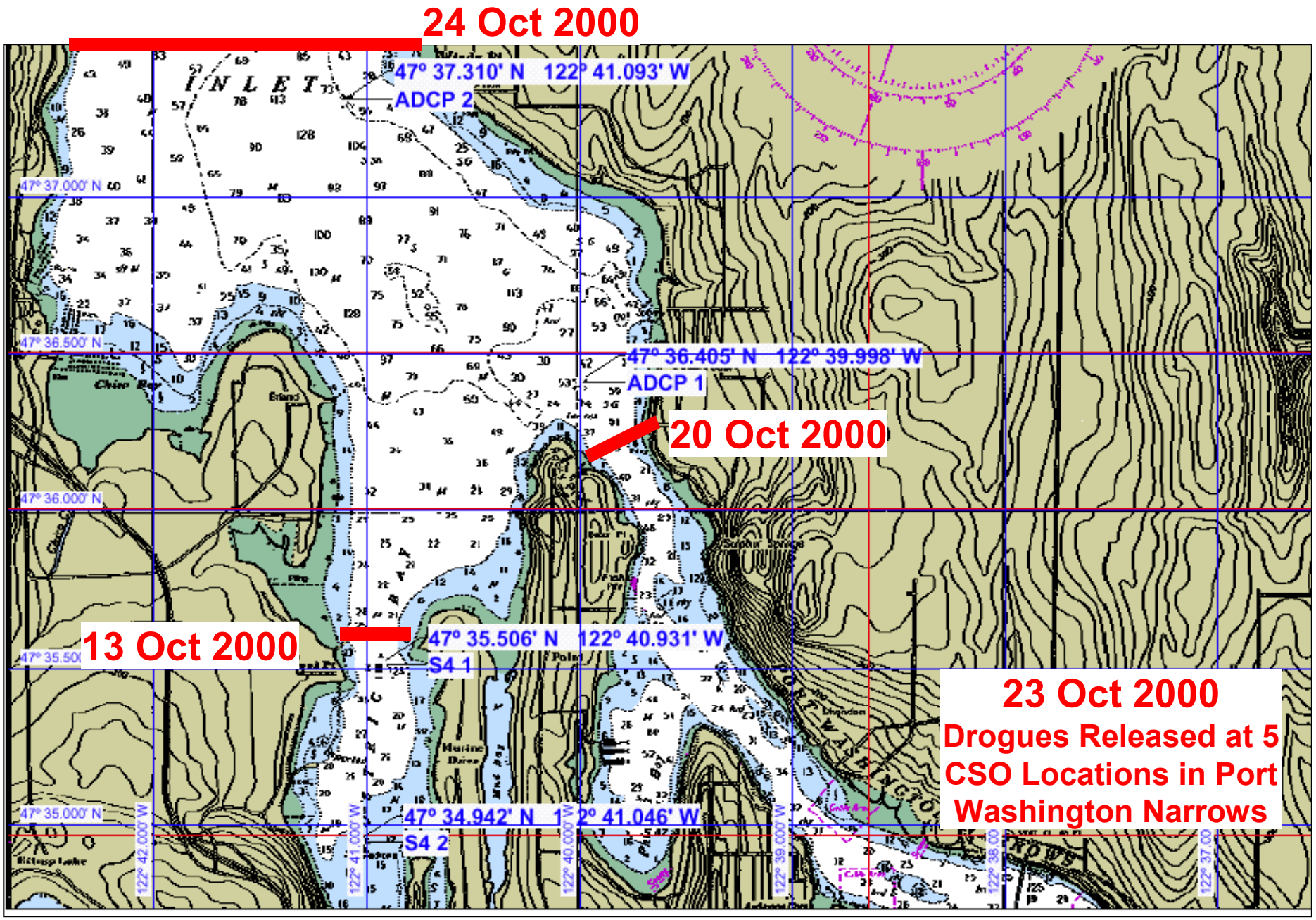
The methodology described is targeted specifically for the purpose stated in the first section of this memo. Further information on the use of drogues for hydrographic evaluations is found in the attached summary from Tim Determan of DOH (summer of 1999). (We need this attached summary.)

## III. Preparation of Results

Results from the three series of drogue releases will be described in a draft report to be written by DOH in collaboration with the Suquamish Tribe. The tribe may provide GIS mapping of the drogue transit paths for the report. The final draft of this report will be submitted to CTC, the Navy, and the City of Bremerton for review and comments. These comments will be considered for incorporation into the final report, which will be issued by DOH and the Suquamish Tribe. CTC and the Navy can use both the final draft and the final report to confirm results of the CH3D-Model.

Attachment

Cc: Kathleen Cahall, City of Bremerton
Marian Rideout, CTC
Steve Swanson, PSNS
Paul Williams, Suquamish Tribe
Jennifer Tebaldi, DOH




**Sampling Plan for Drogue Study**

# APPENDIX
## Discussion on Drogue Study and Improvements to Sampling Plan

-----Original Message-----
From: Meriwether, Frank [mailto:Frank.Meriwether@DOH.WA.GOV]
Sent: Wednesday, September 20, 2000 11:23 AM
To: 'Pei-Fang Wang'; 'Swanson Steven R PSNS'; Billy Johnston (E-mail); Robert Johnston
Cc: Paul Williams (E-mail); Richard Brooks (E-mail); Combs, Greg; Woolrich, Bob
Subject: RE: Draft Dyes Inlet Drogue Study

Thank you again Dr. Wang for reviewing my comments on the draft drogue study for Dyes Inlet. Here are my comments on your last review (of 9/20):

1. Regarding the release sites. We plan to release the set of drogues along a transect, so that there could be one or two of the drogues in each release closer to the shoreline. We won't release any drogue immediately close to the shoreline, but after release any of them could get hung up on something, or grounded on the shoreline. Typically in such cases, it is noted where and when the drogue got hung up, the drogue is retrieved and re-released immediately nearby in deeper water. But we don't expect to have any releases where the streamlines lead directly to any nearby shoreline.

2. Regarding the three days selected for the releases. I don't quite follow your comment. The low slack tide on 10/13 during daylight is at 12:30 PM, so we only have one flood tide cycle to capture that day. October 21st is probably out because it's a Saturday. The low slack on 10/20 is 5:40 AM at Tracyton, but I think we can work with it since we aren't releasing drogues until awhile after low slack. Our third day of release remains sometime during 10/23 through 10/25, which includes a possible fall-back day in case something goes wrong on the 13th or the 20th. But the 25th doesn't look very good now due to another commitment by one of our staff.

3. Use of GPS on the drogues. I think we could manage to use some drogues with the GPS attached to the drogue floats if the unit is not bulky. I don't know their size or weight though. If they are big or heavy I would prefer not to use them. If they are small and light we could use them, and use a companion drogue released next to several of the GPS drogues to see if the GPS alters their transit. It may reduce the number of drogue release points along each transect, but it's workable.

P.S. I believe we're anticipating a return message from Bob Johnston regarding what boats are needed for the ADCP deployment.

Please let us know how all this sounds. I'm going to be putting some drogues together in the next week or so. Thanks,

Subject: RE: Draft Dyes Inlet Drogue Study
Date: Wed, 20 Sep 2000 17:09:34 -0700
From: Pei-Fang Wang <pfwang@spawar.navy.mil>
To: Meriwether Frank <Frank.Meriwether@DOH.WA.GOV>,
'Pei-Fang Wang' <pfwang@spawar.navy.mil>,
Meriwether Frank <Frank.Meriwether@DOH.WA.GOV>,
Swanson Steven R PSNS <swansons@psns.navy.mil>, "Billy Johnston (E-mail)" <johnsonb@ctc.com>,
Johnston Robert K PSNS <johnstonrk@psns.navy.mil>
CC:
"Paul Williams (E-mail)" <pwilliams@suquamish.nsn.us>,
"Richard Brooks (E-mail)" <rbrooks@suquamish.nsn.us>, Combs Greg <Greg.Combs@DOH.WA.GOV>,
Woolrich Bob <Bob.Woolrich@DOH.WA.GOV>

Hi Frank,
Thank you for the speedy response to my review comments. Things are becoming more clear. I know that some of my questions were due to my lack of knowledge regarding your prior experience with the drogue study. I read your attached report by Tim Determan and your reviews. Here are some more comments :

At 02:32 PM 9/12/00 -0700, Meriwether, Frank wrote:

Thank you Dr. Wang for your insightful comments on the draft drogue study for Dyes Inlet. I would appreciate your review of my responses (below) and your subsequent opinions and recommendations, since we want the study results to be useful to you and the model confirmation. I'm mentioning only responses which need some clarification; I am in agreement with your other comments, and so I'll not include them here.

- II.A. The first drogue release site has been selected (across the mouth of the Narrows from Rocky Point). It is possible to go ahead and choose the other two release sites ahead of the first release day. But I think it would be informative to release drogues at or near location(s) where we know the Narrows waters flows, which would be based on results from the first drogue release. One release area is to be in central Dyes Inlet, to observe how Narrows water is directed towards the Windy Point area and toward the shoreline area north of Chico Bay. The other release would be in Ostrich Bay, to observe the same transit of Narrows water towards south Ostrich Bay and into Oyster Bay. These are the shellfish beach areas of interest to the Suquamish. However, please let me know if you have a recommendation for the fixed transects or sites for the second and third day of drogue release, based on information presently available to us.

I think the release locations are good. The only thing that I can add on to it is that we do not want the drogue to get too close to the shores to get grounded. Therefore, if we know in advance that the flow streamline would lead to shores, then we have to make sure the drogues would travel long (both time and space) enough before get to the shores.

- II.A. The selection of the three recommended drogue release days is based on several factors. The strategy was not to capture maximum tidal forcing, but to include major forcing, using the change in tidal prism depth as an index. I use the tide projections at Tracyton for this purpose. You are right in that the maximum tidal forcing happens around Oct 16-17. But that tide cycle happens mainly in the dark, and we need (or want) daylight during the drogue releases. This limitation (and weekend days limitation) cuts out several possible candidate days. The predicted tidal prism depths on Oct. 13, 20, and 23-25 range between 8.9' and 11.3'. If Oct. 23rd is excluded as a possible date, the range is between 8.9' and 10.8', which is not a bad idea since it will give us more consistent tidal forcing conditions. As an idea of the tidal force here, the mean range of tide is 8.4'.

Thanks for pointing out your consideration of weekdays vs. weekends. There are two high and two low tides during Oct. 13 (the first low slack is at 7:00 AM). There will be only one high (with enough tidal ranges) tide in Oct. 20, 21. The low slack occurs at 4:00AM in Oct. 20 and 5:00AM for Oct 21. Maybe we can choose one of these two days.

- II.A. I agree that wind is a significant factor. But we don't have a lot of time window available to be able to select drogue release days based on how much wind there is or could be. Having a day or two in reserve could provide us some flexibility on this point. I am open to your recommendation as to how to measure, monitor and record wind. Maybe that's something the Navy can help with? I hope so.

Probably we will have no control about wind. But at least we need to record the wind during the release study periods. Steve or Billy may have better knowledge about the wind data.

- II.B. To be honest, I don't know how much time I have in the next weeks to find and provide discussions on the validity of drogue studies, to include factors of inertia effects, added mass, and chaotic behaviors. I have conducted drogue studies for DOH in several areas which I could discuss. But I didn't really do a technical analyses of these drogue study results. I have read some journal articles about drogue studies and their application which could be useful, but I may need to do a little lit review to find them again. But am I understanding your comments correctly, that the use of drogues to describe water motions must first be validated before this study can be initiated?

Frank, forgive me for raising this issue. I did some study on reviewing/reading some report/papers about drogue studies. Drift of drogues highly depends on two things: design of the drogues and hydrodynamic conditions. This is why verification is important. That is why I propose to deploy ADCP during our release study, since data from ADCP can provide

information to verify/calibrate drogue study results. Bart (SPAWAR, another experienced field scientist) told me that he used drogues with GPS in them, which can self-record the time series of locations. Data can then be downloaded after retrieval. We can borrow (or rent) 6 from Scripps Institute. Or we can also build some with estimates of ~$500/each. Even thought the timing is a bit pressing, we think we can build ~10 by Oct. 13. Would it be feasible to use both drogues (a few ones with GPS in them and ones without) for comparison or results and confirmation of drogue study data?

- II.B. It would be great if there can be 1-2 ADCPs in Dyes Inlet during the drogue release period. We hope that the Navy and CTC can arrange this. According to my recollection from our meeting in August at CTC, the results of the drogue study were desired before the end of this year. Based on that and the decreasing daylight and the fact that I'll be out of the country most of November, we focused on doing the study in October. But I'm not sure if the ADCPs can be available and installed by the time of the drogue releases.

We will have one ADCP ready by Oct. 13. We may also borrow 2-3 ADCP before Oct 13. We have had at least 4-5 ADCP deployment in Sinclair Inlet in the past. It should not pose major problem for ADCP deployment. We would have to complete the ADCP deployment prior to Oct. 13 (probably in the first part of the week of Oct. 9).

- II.B. I will forward you an electronic copy of the Determan summary when I get it from him. But if I don't get it from him this week I'll fax it to you at 619-553-6305.

I got and read it. Thanks...

Thank you very much,

Frank Meriwether

(360)236-3321

Fax: (360)236-2257

frank.meriwether@doh.wa.gov

Message-ID: <4.2.0.58.20000912094254.00b38880@mailsd1>
From: Pei-Fang Wang <pfwang@spawar.navy.mil>
To: Meriwether Frank <Frank.Meriwether@DOH.WA.GOV>,
'Swanson Steven R PSNS' <swansons@psns.navy.mil>,
"Billy Johnston (E-mail)" <johnsonb@ctc.com>, Robert Johnston
<johnstonrk@psns.navy.mil>
Subject: Re: Draft Dyes Inlet Drogue Study
Date: Tue, 12 Sep 2000 09:47:15 -0700
MIME-Version: 1.0
X-Mailer: Internet Mail Service (5.5.2652.35)
Content-Type: multipart/mixed;
boundary="----_=_NextPart_002_01C01D00.DD9E4DDE"

Frank,
Attached please find my comments to the workplan. I believe that there are some fundamental issues that need to be addressed before the drogue release study. Please let me know if I can provide any further information regarding my comments.
Thanks...

pfw

At 08:42 AM 9/11/00 -0700, Meriwether, Frank wrote:
>Hello to you all.
>Attached (dyesdrogue.doc) is the draft drogue study protocol I said that I'd
>work up for the next meeting at CTC. I'm sorry to hear that the meeting
>scheduled for Thursday is delayed. However, I would like you all to review
>this draft drogue study and send me any comments or corrections within a
>week or two, so that I can incorporate them into a final report that I can
>hand out at the next meeting. Of course, any corrections will also be
>needed before the time we plan to start the study on October 13th.
>Thanks,
>
>
>Frank Meriwether
>(360)236-3321
>Fax: (360)236-2257
>frank.meriwether@doh.wa.gov
>
>"This message may be confidential. If you received it by mistake, please
>notify the sender and delete the message. All messages to and from the
>Department of Health may be disclosed to the public."
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