

Ministry of Environment  
Province of British Columbia

Canada/British Columbia Water Quality  
Monitoring Agreement

**FIELD FILTRATION TESTING**

Total Dissolved Phosphorus and  
Dissolved Ortho-Phosphorus  
Low-Level Blanks

T.N. Webber  
L.W. Pommen  
Resource Quality Section  
Water Management Branch  
Victoria, B.C.  
September, 1989

**TABLE OF CONTENTS**

Page:

1.0 **Introduction**-----1

2.0 **Results and Discussion**

    2.1 De-Ionized Water Only-----2

    2.2 Filter Assembly Without Attached Filter Units---2

    2.3 Filter Assembly With Attached Disposable  
        25 mm Gelman Filter-----4

    2.4 Filter Assembly With Attached Nucleopore Filter  
        Unit and Dry Sartorius Filter Paper-----5

    2.5 Filter Assembly With Attached Disposable  
        47 mm Gelman Filter-----7

3.0 **Conclusions and Recommendations**-----9

**Figure 1** Apparatus For Total Dissolved Phosphorus  
and Dissolved Ortho-Phosphorus Low-Level  
Filtration Blanks-----11

**Table 1** Results For Total Dissolved Phosphorus and  
Dissolved Ortho-Phosphorus Low-Level Blanks----12

## 1.0 INTRODUCTION

Routine water sampling under the Canada-B.C. Water Quality Monitoring Agreement includes the requirement for field filtration for trace metals and low-level dissolved ortho-phosphorus at a number of jointly operated B.C sites. The requirement for field filtering of phosphorus samples has recently been suspended (see page 10).

Field filtration has the potential for introducing data errors due to contamination introduced by the filtration unit and/or during the field filtering process. The Resource Quality Section of Water Management Branch in Victoria initiated a series of laboratory experiments to examine and catalogue the potential for total dissolved phosphorus and low-level dissolved ortho-phosphorus contamination from a number of filtration units and their component parts.

The objective is to develop a field filtration system that is free of significant contamination or absorption of substances collected, field filtered, and laboratory analysed under the Canada-B.C. Water Quality Monitoring Agreement. The field filtering unit must be simple and rugged, as well as easy to use, yet difficult to introduce contaminating agents under normal use. This is especially important where lay collectors hired under the Agreement are concerned.

Water Management Branch has conducted a similar set of laboratory experiments to examine the potential for metals contamination. Water Management Branch is preparing a report at this time.

## 2.0 RESULTS AND DISCUSSION

The following total dissolved phosphorus (TDP) and dissolved ortho-phosphorus (DOP) (low-level) filtration blanks were prepared on July 4, 1988. The results of these blanks are contained in Table 1.

### 2.1 De-Ionized (DI) Water Only

#### 2.1.1 Equipment and Supplies ( refer to figure 1.)

-DI water in 4.5 L containers supplied by the MOE (Ministry of Environment) laboratory.

-100 mL brown glass sample bottles with white, screw-on PE (polyethylene) caps; cleaned by the MOE laboratory.

#### 2.1.2 Procedure

1. DI water poured directly from 4.5 L containers into two sample bottles: BLANK #1; BLANK #14.

2. Samples prepared afternoon of July 4, 1988, shipped to the MOE lab with ice packs and analysed July 5, 1988.

#### 2.1.3 Results

BLANK # 1: DOP <1 ug/L; TDP 1 ug/L.

BLANK #14: DOP <1 ug/L; TDP 2 ug/L.

---

MEAN:                      <1 ug/L                      1.5 ug/L.

#### 2.1.4 Conclusions

Slight TDP contamination noted in both blanks from the DI water and/or the MOE lab cleaned sample bottles.

### 2.2 FILTER ASSEMBLY WITHOUT ATTACHED FILTER UNITS

#### 2.2.1 Equipment and Supplies ( refer to Figure 1.)

-DI water in 4.5 L containers supplied by the MOE lab.

-six 500 mL PE "metals" collection bottles; MOE lab cleaned.

-six 100 mL brown glass sample bottles with white, screw-on PE caps; MOE lab cleaned.

-six sets of filtration apparatus numbered 7 to 12, each comprising a "metals" bottle cap, two polypropylene bulkhead unions, two pieces of 1/4 inch outside diameter (O.D.) and one piece of 3/8 inch O.D. Tygon clear plastic tubing and a 1/4 inch to 3/8 inch stepped PE connector; all MOE lab cleaned.

-one 60 mL disposable plastic syringe coupled with a two-way valve and disposable 25 mm air filter.

### 2.2.2 Procedure

1. DI water poured directly from 4.5 L containers into the six collection bottles.
2. Each of the six collection bottles was fitted with a filtration apparatus.
3. The same syringe and two-way valve unit, connected to the inlet tube of each collection bottle, was used to pressurize all six bottles.
4. The filtration system was flushed with 50 mL DI water before each of each of the six samples were collected.
5. The six sample bottles were filled using the pressurizing system and filtration apparatus: BLANKS #2, #6, #10, #15, #19, and #23.
6. Samples prepared afternoon of July 4, 1988, shipped to the MOE lab with ice packs and analysed July 5, 1988.

### 2.2.3 Results

BLANK #2: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #6: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #10: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #15: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #19: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #23: DOP <1 ug/L; TDP 2 ug/L.

---

MEAN: <1 ug/L; 2.8 ug/L.

#### 2.2.4 Conclusions

TDP contamination noted in all six blanks could have originated from the lab supplied DI water and sample bottles (mean blank of 1.5 ug/L, Section 2.1.3), and the lab washed collection bottles and filtration apparatus (net mean blank of  $2.8 - 1.5 = 1.3$  ug/L).

### 2.3 FILTER ASSEMBLY WITH ATTACHED DISPOSABLE 25 mm GELMAN FILTER.

#### 2.3.1 Equipment and Supplies

- DI water in 4.5 L containers supplied by the MOE lab.
- six 500 mL PE "metals" collection bottles; MOE lab cleaned (same ones used in Section 2.2.1).
- six 100 mL brown glass sample bottles with white, screw-on PE caps; MOE lab cleaned.
- six sets of filtration apparatus numbered 7 to 12 (same sets used in Section 2.2.1), each coupled with a disposable Gelman 25 mm filter.
- one 60 mL disposable plastic syringe coupled with a two-way valve and disposable 25 mm air filter (same unit used in Section 2.2.1).

#### 2.3.2 Procedure

1. DI water poured directly from 4.5 L containers into the six collection bottles.
2. Each of the six collection bottles was fitted with a filtration apparatus.
3. The same syringe and two-way valve unit, connected to the inlet tube of each collection bottle, was used to pressurize all six bottles.
4. The filtration system was flushed with 50 mL DI water before each of the six samples were collected.
5. The six sample bottles were filled using the pressurizing system and filtration apparatus: BLANKS #3, #7, #11, #16, #20, and #24.
6. Samples prepared afternoon of July 4, 1988, shipped to the MOE lab with ice packs and analysed July 5, 1988.

### 2.3.3 **Results**

BLANK #3: DOP <1 ug/L; TDP 3 ug/L.

BLANK #7: DOP <1 ug/L; TDP 2 ug/L.

BLANK #11: DOP <1 ug/L; TDP 3 ug/L.

BLANK #16: DOP <1 ug/L; TDP 3 ug/L.

BLANK #20: DOP <1 ug/L; TDP 4 ug/L.

BLANK #24: DOP <1 ug/L; TDP 2 ug/L.

---

MEAN: <1 ug/L; 2.8 ug/L.

### 2.3.4 **Conclusions**

TDP contamination noted in all six blanks could have originated from the lab supplied DI water and sample bottles (mean blank of 1.5 ug/L., Section 2.1.3), the collection bottle and filter apparatus (net mean blank of 1.3 ug/L., Section 2.2.4), or the Gelman 25 mm disposable filter. The contamination from the Gelman filter could have been in the 0 to 1.3 ug/L range, depending on the level of contamination continuing to be flushed from the collection bottle and filter apparatus which had 1000 mL passed through them at the end of this set of blanks.

## 2.4 **FILTER ASSEMBLY WITH ATTACHED NUCLEOPORE FILTER UNIT AND DRY SARTORIUS FILTER PAPER**

### 2.4.1 **Equipment and Supplies**

-DI water in 4.5 L containers supplied by the MOE lab.

-six 500 mL PE "metals" collection bottles; MOE lab cleaned (same ones used in Section 2.2.1).

-six 100 mL brown glass sample bottles with white, screw-on PE caps; MOE lab cleaned.

-six sets of filtration apparatus numbered 7 to 12 (same ones used in Section 2.2.1), each one coupled with a Nucleopore filter holder and dry Sartorius filter paper.

-one 60 mL disposable plastic syringe coupled with a two-way valve and disposable 25 mm air filter (same unit used in Section 2.2.1).

#### 2.4.2 **Procedure**

1. DI water poured directly from 4.5 L containers into the six collection bottles.
2. Each of the six collection bottles was fitted with a filtration apparatus.
3. The same syringe and two-way valve unit, connected to the inlet tube of each collection bottle, was used to pressurize all six bottles.
4. The filtration system was flushed with 50 mL DI water before each of the six samples were collected.
5. The six sample bottles were filled using the pressurizing system and filtration apparatus: BLANKS #4, #8, #12, #17, #21, and #25.
6. Samples prepared afternoon of July 4, 1988, shipped to the MOE lab with ice packs and analysed July 5, 1988.

#### 2.4.3 **Results**

BLANK #4: DOP <1 ug/L; TDP 2 ug/L.  
BLANK #8: DOP <1 ug/L; TDP 2 ug/L.  
BLANK #12: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #17: DOP <1 ug/L; TDP 3 ug/L.  
BLANK #21: DOP <1 ug/L; TDP 4 ug/L.  
BLANK #25: DOP <1 ug/L; TDP 1 ug/L.

---

MEAN:                    <1 ug/L;            2.5 ug/L.

#### 2.4.4 **Conclusions**

TDP contamination noted in all six blanks could have originated from the lab supplied DI water and sample bottles (mean blank of 1.5 ug/L, Section 2.1.3), the collection bottle and filter apparatus (net mean blank of 1.3 ug/L, Section 2.2.4), or the Nucleopore filter with dry Sartorius filter paper.

The filter/filter paper could have contributed 0 to 1.0 ug/L, depending on the level of contamination continuing to be flushed from the collection bottle and filter apparatus (1500 mL passed through them at the end of this set of blanks). The average TDP contamination has dropped by 0.3 ug/L as compared to the previous two sets of blanks, possibly reflecting a decline in contamination from the collection bottle and filter apparatus with continued flushing.

## 2.5 **FILTER ASSEMBLY WITH ATTACHED DISPOSABLE 47 mm GELMAN FILTER.**

### 2.5.1 **Equipment and Supplies**

- DI water in 4.5 L containers supplied by the MOE lab.
- six 500 mL PE "metals" collection bottles; MOE lab cleaned (same ones use in Section 2.2.1).
- six 100 mL brown glass sample bottles with white, screw-on PE caps; MOE lab cleaned.
- six sets of filtration apparatus numbered 7 to 12 (same sets used in Section 2.2.1), each one coupled with a disposable Gelman 47 mm filter unit.
- one 60 mL disposable plastic syringe coupled with a two-way valve and disposable 25 mm air filter (same unit used in Section 2.2.1).

### 2.5.2 **Procedure**

1. DI water poured directly from 4.5 L containers into the six collection bottles.
2. Each of the six collection bottles was fitted with a filtration apparatus.
3. The same syringe and two-way valve unit, connected to the inlet tube of each collection bottle, was used to pressurize all six bottles.
4. The filtration system was flushed with 50 mL DI water before each of the six samples were collected.

5. The six sample bottles were filled using the pressurizing system and filtration apparatus: BLANKS #5, #9, #13, #18, #22, and #26.

6. Samples prepared afternoon of July 4, 1988, shipped to the MOE lab with ice packs and analysed July 5, 1988.

### 2.5.3 **Results**

BLANK #5: DOP <1 ug/L; TDP 2 ug/L.

BLANK #9: DOP <1 ug/L; TDP 2 ug/L.

BLANK #13: DOP <1 ug/L; TDP 3 ug/L.

BLANK #18: DOP <1 ug/L; TDP 2 ug/L.

BLANK #22: DOP <1 ug/L; TDP 2 ug/L.

BLANK #26: DOP <1 ug/L; TDP 2 ug/L.

---

MEAN:                    <1 ug/L;            2.2 ug/L.

### 2.5.4 **Conclusions**

TDP contamination noted in all six blanks could have originated from the lab supplied DI water and sample bottles (mean blank of 1.5 ug/L, Section 2.1.3), the collection bottle and filter apparatus (net mean blank of 1.3 ug/L, Section 2.2.4), or the Gelman 47 mm disposable filter. The contamination from the Gelman filter could have been in the 0 to 0.7 ug/L range, depending on the level of contamination continuing to be flushed from the collection bottle and filter apparatus (2000 mL passed through them at the end to this set of blanks). The average in TDP contamination has dropped by 0.3 ug/L as compared to the previous set of blanks, possibly reflecting a continuing decline in contamination from the collection bottle and filter apparatus with continued flushing.

### 3.0 CONCLUSIONS AND RECOMMENDATIONS

The dissolved ortho-phosphorus blanks were less than the detection limit of 1 ug/L for all of the filtration equipment tested. Thus, any of the systems tested could be used for DOP, subject to further testing for absorption, cleaning, practicality and cost.

All of the total dissolved phosphorus blanks were contaminated with 1 to 4 ug/L TDP, which is relatively high compared to the normal detection limit of 3 ug/L for TDP. The DI water and/or sample bottles contributed an average of 1.5 ug/L. The collection bottles and filter apparatus (without filter units) contributed an average of 1.3 ug/L, and the filter units contributed indeterminate amounts between 0 and 1.3 ug/L.

There was a tendency for the contamination to decrease with increasing volume of DI water passed through the collection bottle/filter apparatus suggesting that the collection bottle/filter apparatus was being cleaned by repeated flushing.

Further testing to identify the sources of TDP contamination is recommended:

- (i) analyse the DI water for TDP to determine whether the water or the sample bottles are the source of contamination. If the DI water is < 1 ug/L, consideration should be given to concentrating the DI water to determine the actual levels of TDP.
- (ii) prepare blanks on the 500 mL collection bottles and the 100 mL brown glass sample bottles separately to determine if MOE laboratory washing procedures are adequate. Any changes in washing procedures should apply to all parts of the filtration system.
- (iii) if contamination in the DI water, collection bottles, and sample bottles can be reduced to acceptable levels (i.e. <1 ug/L), then lab washed or new filter units and filter apparatus should be tested with blanks. The goal should be to achieve <1 ug/L for the complete filtration system.

**NOTE:**

Since the preparation of these blanks, the Data Standards Group of the Ministry of Environment and Zenon Environmental Inc. have determined that field filtering of low-level phosphorus samples is not necessary ( May 19, 1989 Memorandum to Environmental Section Heads from Mr. N.R. McQuaker, Manager, Data Standards Group.) Further testing of filtration equipment for phosphorus has been suspended although both field filtered and non-filtered low-level ortho-phosphorus samples and blanks are being collected at the Kootenay River at Creston (a jointly operated, Canada/British Columbia Water Quality Monitoring Site).



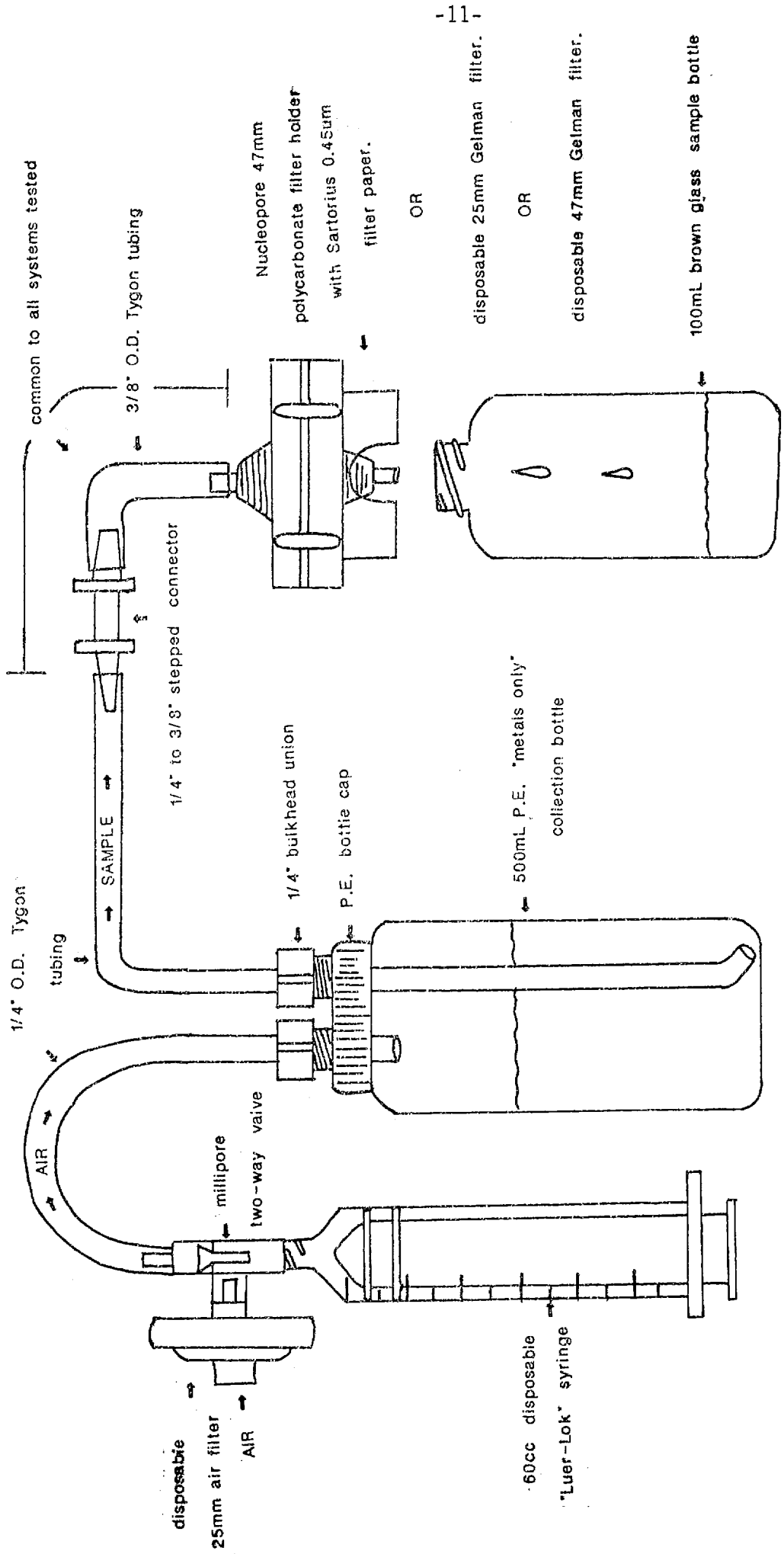


FIGURE 1

APPARATUS FOR TOTAL DISSOLVED PHOSPHORUS & DISSOLVED

ORTHOPHOSPHORUS LOW-LEVEL FILTRATION BLANKS

T A B L E 1

RESULTS FOR TOTAL DISSOLVED PHOSPHORUS AND DISSOLVED ORTHO PHOSPHORUS LOW-LEVEL BLANKS  
( Expressed in ug/L )

EQUIPMENT SET NUMBER	COLLECTION BOTTLE a. WITH CAP			COLLECTION BOTTLE b., CAP, TUBING f. AND SAMPLE BOTTLE WITH CAP.			COLLECTION BOTTLE, CAP, TUBING, NUCLEOPORE FILTER WITH DRY PAPER AND SAMPLE BOTTLE WITH CAP.			COLLECTION BOTTLE, CAP, TUBING, 47 mm FILTER AND SAMPLE BOTTLE WITH CAP.								
	BLANK c. TIME	d. DOP	e. TDP	BLANK TIME	DOP	TDP	BLANK TIME	DOP	TDP	BLANK TIME	DOP	TDP	BLANK TIME	DOP	TDP			
#1	-	<1	1	2	<1	3	3	2:00*	<1	3	4	0:30	<1	2	5	1:00	<1	2
#2				6	<1	3	7	1:00	<1	2	8	-	<1	2	9	-	<1	2
#3				10	<1	3	11	-	<1	3	12	-	<1	3	13	-	<1	3
#4		<1	2	15	<1	3	16	1:45*	<1	3	17	-	<1	3	18	-	<1	2
#5				19	<1	3	20	-	<1	4	21	-	<1	4	22	-	<1	2
#6				23	<1	2	24	-	<1	2	25	-	<1	1	26	-	<1	2
MEAN		<1	1.5		<1	2.8			<1	2.8			<1	2.5			<1	2.2

COMMENTS

- a. Sample Bottle: 100 mL brown glass with a white polyethylene (PE) screw cap; lab cleaned.
- b. Collection Bottle: 500 mL PE "metals only" bottle; lab cleaned.
- c. Blank: number corresponds to depth range number on individual lab reports.
- d. TIME = minutes : seconds (to filter 100 mL).
- e. DOP = Dissolved Ortho Phosphorus, low-level. TDP = Total Dissolved Phosphorus.
- f. The arrangement of tubing and connectors etc. used for the blanks is shown on Figure 1. The same 1/4 inch to 3/8 inch stepped connector and 2 inch piece of 3/8 inch outside diameter (O.D.) Tygon tubing was used for all filtration systems tested.
- All blanks prepared with de-ionized (DI) water supplied by the Environmental Laboratory.
- The same syringe, 2-way valve and air filter were used on all blanks (see Figure 1).
- All Nucleopore filters, tubing and connectors were lab cleaned; all 25 mm and 47 mm filters were used as received from the supplier; all assembled apparatus flushed with 50 mL DI water before use.
- \* High initial pressure was needed to start water flowing through the filter. Some foam was observed at the start of the flow due to trapped air forced through the filter paper.
- Samples shipped to the environmental lab packed in a cooler with ice packs. Samples analysed within 24 hours of shipping.