Investigation and Demonstration of Turbidity Reduction in Stormwater Runoff for Oklahoma Highway Construction Sites

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16. ABSTRACT

The Environmental protection Agency (USEPA) has issued new requirements on the construction industry to control the discharge of pollutants from the sites. The construction effluent guidelines or ELG's require construction sites to reduce the pollutant discharge to 'maximum extent practicable' and comply with the Clean Water Act. Sediment is the primary pollutant in a construction site effluent runoff. It is mainly composed of large amounts of fine silt, clay and colloidal particles. These particles have low settling velocities and remain in suspension for long durations and therefore cannot be trapped effectively in conventional BMP's like detention ponds, grass lined channels, sedimentation basins that rely on gravity for settling. The trapping efficiencies of the particles can be enhanced by flocculation, where addition of the flocculant to the sediment discharge would bind multiple particles together, increasing them in size and increasing the settling velocity. Construction sites often experience space restrictions and therefore a modular sediment trapping system based on flocculation would require much less space compared to a settling pond especially in those regions which have high clay content in their soil, which is commonly found in state of Oklahoma. The following report presents the improved design for our passive flocculent and mixing devices. The report also includes all the experimental data collected with the flume experiments performed on the five soils from the state of Oklahoma namely Port A and Port B, Kamie B, Stephenville B and Norge B soils. The values of the flocculation constants associated with each soil are presented. Additionally, field tests on a field with Port soils are presented

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CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

CONVERSION FACTORS FROM SI* UNITS

CONVERSIONS FROM SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
^oC	Celsius	1.8C+32	Fahrenheit	^oF
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

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Executive Summary

New EPA requirements on the construction industry have been issued as Construction Effluent Limitation Guidelines, or ELG's. The ELG's require the discharge of pollutants from construction sites be reduced to the "maximum extent practicable" (MEP) in order to protect water quality and satisfy the appropriate water quality requirements of the Clean Water Act. Sediment is the primary pollutant in the construction site runoff and is composed of very fine particles such as fine silts, clays and colloidal particles that do not aggregate easily and remain in suspension for very long durations. These settling rates can be increased by flocculation that allows the particles to aggregates forming flocs, which have larger sizes, and settling velocities. 'Design of turbidity control for Oklahoma Highway Construction' was done for Oklahoma Department of transportation and the objectives of the project were:

1. Estimate flocculation and turbidity constants for five Oklahoma soils, which are required to model the sediment removal efficiency and outflow turbidity for a site-specific passive chemical injection system design.
2. Investigate the validity of using laboratory jar test results to design the OSU Flocculant Injection and Mixing System for removal of sediment from construction site runoff.
3. Design, install, monitor, and demonstrate the OSU Flocculant Injection and Mixing System for turbidity reduction at an active ODOT construction project.

Task 1: Estimate flocculation and turbidity constants for five Oklahoma soils, which are required to model the sediment removal efficiency and outflow turbidity for a site-specific passive chemical injection system design.

Five soils Port A, Port B, Kamie B, Norge B, Stephenville B were analyzed with the help of flume experiments. The mathematical model described in the report was used to determine the stickiness coefficient of the soils. Greater the value of coefficient, greater is the capacity of the soil to flocculate which would correspond to greater reduction in the turbidity. The value of the sediment removal efficiency, turbidity reduction and stickiness coefficients for all the soils, is presented in the table below.

Soil Type	Sediment removal efficiency (%)	Turbidity Reduction (%)	Stickiness coefficient (%)
Port A	31	77	0.38-0.84
Port B	43	76	1.15-1.5
Kamie B	39	82	0.8-1.2
Stephenville B	52	77	1.2-1.5
Norge B	39	65	1.1-1.5

Task 2: Investigate the validity of using laboratory jar test results to design the OSU Flocculant Injection and Mixing System for removal of sediment from construction site runoff.

For this task, we completed a series of jar tests to investigate the relationship of several parameters involved in the flocculation process to turbidity reduction efficiency. Additionally, we used similitude relationships to investigate the hydraulics inside a jar test both during spinning and after the paddle has stopped spinning. These relationships will be used to further quantify and compare jar test results with our flume and field test results in future research.

In addition to these jar tests, similitude relationships between a conventional jar test and a large-scale jar test were investigated to begin the process of developing a method to determine stickiness coefficients without the laborious flume process.

Task 3: Design, install, monitor, and demonstrate the OSU Flocculant Injection and Mixing System for turbidity reduction at an active ODOT construction project.

The field injection and mixing system were improved so that it can be easily installed in field. The advantages of the improved design are as follows:

1. It employs a flow control structure that uses a stage-discharge relationship with prepositioned float valves that allow passive, standalone flocculent dosing to actuate and terminate at designed discharges.
2. Addition of improved gate valves in the passive flocculent dosing apparatus enable better control of flocculent flow rates during operation.
3. It utilizes open channel mixing structures developed based on existing inline static mixers for pipes.
4. Uses a backwater control structure to induce a hydraulic jump at a desired location to facilitate flocculent mixing.

To summarize, the use of the field system in conjunction with the computer model can help ODOT predict flocculation and turbidity reduction efficiency on their construction sites and therefore control the discharge of sediments in stormwater runoffs more effectively.

Introduction

The Oklahoma Department of Transportation (ODOT) is the owner of construction projects that require stormwater permits. New EPA requirements on the construction industry have been issued as Construction Effluent Limitation Guidelines, or ELG's. The ELG's require the discharge of pollutants from construction sites be reduced to the "maximum extent practicable" (MEP) in order to protect water quality and satisfy the appropriate water quality requirements of the Clean Water Act. Space limitations at linear construction sites also lend themselves to utilizing flocculation for sediment removal because much less space is needed for settling ponds in areas where the soil has a relatively high percentage of clay, which is often the case in Oklahoma.

Sediment in stormwater from construction site runoff may include a large amount of particles having smaller diameters, such as fine silt, clay and colloidal particles. These particles have a relatively low settling velocity and often do not form aggregates easily; thus, they will remain in suspension and cannot be effectively removed by conventional BMP's. To enhance settling rates, flocculation or coagulation amendments may be added, which will bind particles and bridge multiple particles together, thereby, increasing their effective size and ultimately their settling rate. However, to implement flocculation for turbidity control at highway construction sites, ODOT must have way to predict flocculation performance in the field, an implementable device that can be deployed in the field to efficiently deliver flocculent to stormwater runoff, and a computational model to size this device for individual construction sites. It is important to note that each construction site is unique, therefore the one size fits all BMP design will likely not achieve the desired trapping of sediment. The components of a sediment control BMP that can meet the standard will be:

1. A sediment forebay with a defined outlet system

2. A flocculent injection system

3. A mixing section for controlling floc mixing and growth, and

4. A settling basin to allow flocs to settle out.

The area required to install one BMP is not likely to be prohibitively large. While this may seem like a complex system, it is actually a treatment train of systems that have long been used in other water management arenas and have lately been modified for construction sediment control (McLaughlin and Bartholomew, 2007). The missing piece from other research is the ability to predict, with acceptable accuracy, the effectiveness of varying designs on effluent sediment concentration and turbidity. Providing a prediction capability and making it available as a user-friendly design aid is critical to the cost effective design and implantation BMPs.

Objectives

The objectives of the project are:

1. Estimate flocculation and turbidity constants for five Oklahoma soils, which are required to model the sediment removal efficiency and outflow turbidity for a site-specific passive chemical injection system design.
2. Investigate the validity of using laboratory jar test results to design the OSU Flocculant Injection and Mixing System for removal of sediment from construction site runoff.
3. Design, install, monitor, and demonstrate the OSU Flocculant Injection and Mixing System for turbidity reduction at an active ODOT construction project.

Special attention and consideration will be made to optimize the injection and mixing system.

Theory of the Flocculation Process

The deposition of sediments in surface runoff depends on their effective settling velocity, which is affected by flocculation efficiency (Winterwerp, 1998). Flocculation consists of aggregation and breakup processes that control and limit floc growth. Particle aggregation is primarily controlled by particle collision, which is produced by Brownian motion, laminar and turbulent shear forces, and differential settling. Floc breakup results from flow forces and the collision with other particles and aggregates.

Flocculation processes have been studied by many researchers with a consensus that the floc dynamics depends on the flow condition, the physical and the biochemical properties of the water, and the primary particles (Son and Hsu, 2008). Therefore, to effectively measure sediment transport and deposition it is necessary to measure the evolution and breakup of flocs. The formation and breakup of flocs is dependent on several variables, and when the two are in balance, the flocs reach a steady state for a given shear rate. The floc strength may therefore be determined based on steady-state floc size for a particular shear rate and is highly dependent on the floc formation process (Jarvis et al., 2005).

Floc formation is accomplished in a two-step process: coagulation followed by flocculation. Coagulation is a process of destabilization of particles, which can be accomplished either by double layer compression, or chemical bridging and pH_{zpc}. In the double layer theory, the maximum concentration of cations (negatively charged ions) is near the surface of the colloid. This concentration decreases with the increase in the distance from the surface of the colloid. The concentration gradient creates a force of repulsion amongst the clay particles because like charges have a tendency to repel each other. The layer near the surface of the colloid in which the concentration of the counter ions is increased is called the diffuse layer. Addition of the coagulant increases the concentration of the counter ions (positively charged ions), increasing the Van der Waal's forces of attraction and the clay particles get destabilized and get attracted to each other. At sufficiently high concentrations, the potential energy barrier is eliminated and the particles destabilize allowing the formation of flocs.

Chemical bridging is a second mechanism in which a polyelectrolyte is considered as a coagulant and it forms long chains with the colloidal particle by absorption. Since polyelectrolytes have long lengths, they can diffuse easily into the diffuse layer and get absorbed on the surface of the colloidal particle. This process leads to flocculation. Thus, to summarize, coagulation is a process of particle destabilization and flocculation is a process where destabilized particles form aggregates and settle down (Kang et al., 2007, Haan et al., 1994).

Factors Affecting Flocculation

In order for flocculation to occur, particles must collide, stick together, and grow (Davis and Cornwell, 1998). To describe the interaction of different particle sizes with each other, the general dynamic equation of flocculation used is:

$$\frac{dn}{dt} = \frac{1}{2} \sum_{v_1+v_2+v_3} \beta(r_i, r_j) n_i n_j - n \sum_{i=1}^{\infty} \beta = (r_i, r_j) n_i$$

where β is the collision frequency function for class *i* and *j* particles, r_i and r_j are the radii of class *i* and *j* particles, and n_i and n_j are the concentrations of class *i* and *j* particles (Clark, 1996). Particles generally collide due to laminar shear forces, turbulent mixing (large particle interactions), Brownian motion (small particle interactions), or differential sedimentation (large particle interactions with large relative settling velocities). The collision frequency function for laminar shear can be described by:

$$\beta(r_i, r_j)_{ls} = \frac{4}{3}(r_i + r\ )^3 \frac{du}{dx}$$

where u is the turbulent velocity of the particles in ft/s. The collision for turbulent mixing is given by:

$$\beta(r_i, r_j)_t = 1.294(r_i + r\ )^3 (\frac{\varepsilon}{\nu})^{\frac{1}{2}}$$

where ϵ is the local average unit mass energy dissipation rate in the turbulence and *v* is the kinetic viscosity. The change in the number of particles, described by Parker et al. (1972), is a function of G, the dissipation parameter (or shear rate) and is given by the following equation (Son and Hsu, 2008):

$$G = \sqrt{\varepsilon / \nu}$$

The collision for Brownian motion is defined as:

$$\beta(r_i, r_j)_{bm} = \frac{2kT}{3\mu}(\frac{1}{r_i} + \frac{1}{r_j})(r_i + r_j)$$

where *k* is Boltzman's constant, T is the absolute temperature, and *μ* is the electrical motility of the charged particles. The β for differential sedimentation is given by:

$$\beta(r_i, r_j)_{ds} = \pi(r_i + r_j)^2 (v_i + v_j)$$

where v_i and v_j are settling velocities of the class *i* and *j* particles (Krishnappan and Marsalek 2002).

Once particles collide, they must stick together in order to form a floc. The ‘α’ is a parameter that defines the probability of a colloidal particle permanently sticking to the floc after a collision. Floc growth is the product of the rate of particle collision and its ability to stick, i.e. floc aggregation, and floc breakup (Jarvis et al., 2005). There are several procedures for predicting changes in particle size due to flocculation (Haan et al., 1994); one of these is proposed by Argaman and Kaufman (1970). Their proposed rate of flocculation is given by:

$$H_{1F} = -4\pi K_s \alpha R_F^3 \eta_1 \eta_F \left[\mu'^2\right]_a$$

where K_S is a parameter that relates the effectiveness of the mean square turbulent velocity, [u'^2], in mixing, R_F is the radius of the floc, n_1 is the number of colloidal particles, and n_F is the number concentration of flocs. Their proposed rate of floc breakup is given by:

$$B_{1T} = B\frac{R_F^2}{R_1^2}\eta_F \left[\mu'^2\right]_a$$

where *B* is a floc breakup constant and R_1 is the radius of the colloidal particle. An algorithm to calibrate the parameters of the model was developed by Ayesa et al. (1991). Other models that consider the simultaneous effects of flocculation and floc breakup are described by Parker et al. (1972) and Winterwerp (1997).

The settling and flocculation model (S&FM) by Krishnappan (1990) involves the flocculation stage and settling stage (Krishnappan and Marsalek, 2002). The coagulation equation (similar to the *general dynamic equation)* was used to describe the flocculation stage. The equation expresses the number-concentration balance of particles undergoing coagulation as a result of collision of particles of different sizes, given as:

$$\frac{\partial N(i,j)}{\partial t} = -\beta N(i,t)\sum_{j=1}^{\infty} K(i,j)N(j,t) + \frac{1}{2}\beta\sum_{j=1}^{\infty} K(i-j,j)N(i-j,t)N(j,t)$$

where *N*(*i,t*) and *N*(*j,t*) are the number-concentrations of particle size classes *i* and *j*; respectively, at time *t*; *K*(*i,j*) is the collision frequency function, which is a measure of the probability that a particle of size *i* collides with a particle of size *j* in unit time; and, β is the coagulation factor, which defines the probability that a pair of collided particles coalesce and form a new particle (Krishnappan and Marsalek, 2001).

In natural systems, flow is typically turbulent. Therefore, particle interaction due to Brownian motion and differential settling are almost negligible, and turbulence is typically the dominant process that causes particle interactions. The above models were developed accounting for turbulent mixed flocculation. In order to generate turbulence in the laboratory, coagulation devices are used. The commonly used devices are paddle mixers, static grids, oscillating grids and couette mixers. Paddle mixers have spatially varying shear rates and the maximum shear rates are observed at the center near the blades of the impeller. Oscillating grids can create effective turbulence but again have spatially varying shear rates depending upon the stroke length and oscillating frequency. The turbulence generated by these mixers is anisotropic in nature, and is not freely decaying. A static grid, on the other hand, generates freely decaying, isotropic turbulence (Roach, 1986). Serra et al. (2007) evaluated the efficiency of three different mixing devices: paddle mixer, oscillating grids and couette mixers. They concluded that the couette mixing device produced large flocs compared to the other two devices.

Once a floc is formed, its strength depends on the number and strength of the individual bonds within the floc (Jarvis et al., 2005). If the strength of the individual bonds is less than the stress applied at its surface, the floc will breakup. Generally, floc strength is measured either macroscopically (measures energy required in the system for floc breakage) or microscopically (measures the inter-particle forces within individual flocs) (Jarvis et al., 2005). To measure floc strength macroscopically, increased shear rate can be applied to the formed floc and related to the energy dissipation applied to the maximum or average floc size remaining (Jarvis et al., 2005). One example used to measure floc strength macroscopically is impeller-based systems. This is accomplished by applying a known shear rate to a grown floc suspension within a vessel. Other methods use light scattering to measure floc size or the analysis of video frames or photographs. Two methods for measuring floc strength microscopically are the mechanical and manipulation approaches. For the micromechanical method, floc strength is measured by the tensile force required to break single flocs (Yeung et al. 1997). Zhang et al. (1999) used a micromanipulation method where they measured the compression force required to break flocs between a glass slide and a fiber optic probe (Jarvis et al., 2005).

When the shear rate increases beyond the critical point, flocs break up until equilibrium is restored. Once flocs breakup, some of the broken fragments will not be able to reform (Jarvis, 2005). The process of floc breakup (an erosion of primary particles from the surface and fragmentation of the flocs) by Argaman and Kaufman (1970) has already been discussed (Jarvis, 2005). Thomas (1964) concluded that under turbulent conditions the rupture of flocs is predominantly due to the pressure differences on opposite sides of the floc. Matsuo and Unno (1981) found that floc breakup results predominantly from the surface shear brought about by the difference in deformability between the surrounding fluid and the floc (Jarvis, 2005). Settling velocity is another important measure in the process of flocculation. A one-dimensional unsteady advection-diffusion equation used to analyze the settling stage is given by:

$$\frac{\partial C_k}{\partial t} + w_k \frac{\partial C_k}{\partial z} = \frac{\partial}{\partial z}(D \frac{\partial C_k}{\partial z})$$

where C_k is the volumetric concentration of sediment of the k^{th} size fraction and w_k is the fall velocity of that fraction, D is the turbulent diffusion coefficient, t is the time, and z is the vertical distance from the water surface. Particle settling velocity is dependent on a large number of parameters such as the particle's shape, size, and density and is influenced by the temperature and viscosity of the water (Kang et al., 2007). Stoke's law is used to calculate the velocity of spherical falling particles under laminar steady-state conditions;

however, this equation cannot be used when the flocculating particles are continually changing in size and shape (Davis and Cornwell, 1998).

Since flocs never follow the assumptions of Stoke's law, other techniques to measure settling velocity are necessary. Ha and Maa (2010) estimated the relation between the suspended sediment concentration (SSC), turbulence, and settling velocity in a laboratory tank by using a 5-MHz acoustic Doppler velocity meter (ADV). The objectives were to examine the dependence of settling velocity on the SSC and turbulence, to evaluate the confidence of ADV-derived settling velocity by comparing it with other approaches such as Owen tube (OT), and to elucidate the limitation and possible improvement of ADV's analytical approach for estimating the settling velocity. They found that settling velocity increased non-linearly with SSC in the range of 300-700 mg L^{-1}, and the turbulence can increase the settling velocity up to one order of magnitude higher than the settling velocity for non-turbulent conditions. This turbulence effect can explain why the settling velocity derived by the ADV is 1 to 3 orders of magnitude higher than settling velocity estimated by Owen tube (OT), where the ambient turbulence was totally blocked, and OT itself caused breaking of the flocs while trapping samples into the tube. Besides, the collected sediment particles (flocs) may stick to the inner wall of the tube during the settling, which leads to retarding the settling velocity. The settling velocity in this study was expressed as a function of SSC, given as:

$$W_s = mC^{n-1}$$

where m and n are empirical constants, C is the sediment concentration, and w_s is the settling velocity. Results showed that settling velocity was positively correlated with SSC. Higher SSC levels contribute to the increase in settling velocity. Overall, Ha and Maa (2010) concluded that the ADV is a useful tool to concurrently measure the instantaneous current velocities, SSC, and W_s in turbulence-dominant environments without breaking up flocs and disturbing ambient flow.

Khelifa and Hill (2006) use a modified Stoke's law (Batchelor, 1991) to develop an equation to express the settling velocity of flocs, given as:

$$V_f = (\frac{4}{3}\theta g C_d^{-1}\frac{\Delta\rho}{\rho_w}D_f)^{0.5}$$

where θ is a dimensionless particle-shape factor, g is the gravitational acceleration (ms^{-2}), C_d is the dimensionless drag coefficient, $\Delta\rho = \rho_f - \rho_w$ is the effective density (excess density) of the floc (kg m^{-3}), D_f is the equivalent spherical diameter of the floc (m), and ρ_f and ρ_w are floc and water densities, respectively(kg/ m^3). A consistent decrease of the effective density of flocs with increasing size was observed. The floc size covered by these data varied between 1.4 and 25,500μm. The result showed that, with the proposed models, the spread in these data may be reproduced by varying the size of primary particles from about 0.05 to 20μm.

Measurement of Flocs

From the extensive research that has been carried out in the area of the flocculation, it is clear that the change in the floc size needs to be considered, as the settling velocity of the particles depends upon the floc size (Son and Hsu, 2008). A number of techniques have been developed for the measurement of the floc size. However, the accuracy of these techniques in determining the floc size has been challenged because of the inherent irregularity of the floc shape in both two and three dimensions (Jarvis et al., 2005). Some of the major techniques used for floc size determination are:

- Light scattering: Back/ front light scattering by flocs
- Measuring the settling velocity of the flocs
- Photography and image analysis
- Microscopy: observation of floc size under both static and dynamic conditions

Scattering of Light

The main principle behind the light scattering technique to measure aggregates is that scattered radiation is in a function of the scattering angle, which is the function of the length scale of the matter. In the scattering of light technique, X-rays, lasers, neutrons and visible light have all been used to measure aggregate size. Use of visible light is the quickest and most inexpensive technique.

Settling

The settling technique is used as a complimentary technique to light scattering technique for the measure the size of the aggregates. Presented earlier is the relation between the settling velocity, the effective density and effective diameter of the particle. The settling velocity is also called the terminal velocity U_t, and under the influence of the gravity, drag force, and buoyancy, the terminal velocity can also be expressed as:

$$U_t^2 = \frac{V_a}{A_a C_D} \frac{2(1-\varepsilon)(\rho_p - \rho_l)g}{\rho_l}$$

where V_a is the aggregate volume, A_a is the aggregate projected area, ε is the aggregate porosity, and ρ_p and ρ_l are the mass density of the particle and the fluid, respectively. C_D is the coefficient of drag, and *g* is the acceleration due to gravity (Bushell et al., 2002).

Image Analysis

Image analysis is one of the oldest techniques used in particle characterization. In image analysis, direct images of flocs are obtained from transmission electron microscopes, or high resolution CCD cameras. From the images of the aggregates, the structure and size of the aggregate can be determined using simple techniques like ‘box counting’ (Bushell et al., 2002).

Prediction of Floc Growth Based on Change in Concentration

Alternatively, the Argaman and Kauffman model, as discussed previously, assumes that the change in the number concentration of the primary particles is directly proportional to the radii of the primary particles and flocs under consideration. Tapp et al. (1981) modified this model to measure the change in the mass concentration of the primary particles by multiplying the number of the primary particles by the density of the flocs. The equation determining the change in the mass concentration of the flocs is given by:

$$\frac{dc}{dt} = -4\pi\alpha K_s R_F^3 n_F U_i^2 c + \frac{4\pi}{3} B R_F^2 n_F R_1 \rho_s U_i^2$$

where c is the mass per unit volume of particles to be flocculated, or mass concentration of the particles to be flocculated. Further, Tapp et al. (1981) showed that the inverse of floc radius and the root mean square velocity gradient had a linear relationship. The size of the flocs can be derived mathematically and statistically by using the above equation.

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Methods

Task 1 Methods

Estimate flocculation and turbidity constants for six Oklahoma soils, which are required to model the sediment removal efficiency and outflow turbidity for a site-specific passive chemical injection system design.

Description of the Experimental Flume Apparatus

The main components of the experimental apparatus were

- Soil separator to separate sand and large aggregates from small aggregates, and silt and clay particles from the bulk soil
- Sediment injection system
- Constant head tank to provide constant flow into the flume
- Flocculant injection system
- Oscillating grid assembly to produce isotropic turbulence and mix the sediment and the flocculant
- Flume with the sampling ports to measure the suspended sediment's concentration, and trays to measure the total deposited sediment.

Soil Separator

Sand and large aggregates do not typically flocculate, and have higher settling velocities compared to silt and clays. In a field application the forebay will likely trap most, if not all of these sand and large aggregates. Thus, a soil separator was designed based on Stoke's Law to remove sand and the large aggregates from the bulk soil used in our laboratory experiments. Each particle size class had a different settling velocity. The particles in the size class of sand and greater had settling times less than, or equal to 13 seconds. The weir had a flow depth of 1.18 inches, and the length of the soil separator was 10ft, which was calculated based on the settling velocity of a small sand particle (0.05 mm diameter). Dry soil was mixed with water having an approximate flow of 23 gpm. Slurry consisting of all particles having a size less than sand was discharged over a rectangular weir. Figure 1 shows a picture of the soil separator.

Soil injection system

The slurry, which primarily consisted of silt, clay and small aggregates, was pumped into a conical tank for uniform mixing and storage. When the sediments in the slurry settle in the tank they form a thick bed at the bottom of the tank. The sediment slurry required mixing well before it was injected into the flume to obtain a uniform concentration distribution. Thus, the sediment injection system was designed to operate in two modes: normal flow mode, and back flush mode. Under the normal flow mode the sediment coming from the bottom the tank was re-circulated back into the tank from the inlet at the top of the tank. The back flow mode was used when the sediment had settled for a long time in the tank and needed to be mixed. Once the initial mixing was done, the back flow mode was reverted to normal flow mode. An impeller was also mounted on top of the tank to ensure that the slurry was well mixed. Figure 2 and Figure 3 show the schematic diagram of the sediment injection system in normal and back flow operating modes, and Figure 4 shows the picture of the sediment injection system.

Constant Head Tank

A uniform flow rate of 0.1 cfs was maintained in the flume by use of a constant head tank. Figure 5 shows a diagram of the constant head tank, and Figure 6 shows a picture of the constant head tank. The tank has dimension of 10 ft X 5 ft X 3 ft (L X WX H). Flow straighteners were installed in the tank as shown in the diagram. The constant head tank has a V- notch weir at one end, and a tailgate at the other end. A water level of 6 inches over the V-notch weir corresponded to a flow of 0.1 cfs. A point gauge was installed on the stilling well. The point gauge reading of 2.592 was equal to a level 6 inches above the V-notch. This reading was maintained constant and calibrated. The water flowing from the backside of the constant head tank into the overflow tank was recirculated back into the feed water tank.

Flume Flocculant Injection System

Hydrofloc 445L™ was the flocculant used to test all the soils. The flocculant was mixed to concentration of 30g/L in the tank as shown in Figure 7. The flocculant flow rate using the peristaltic pump was calibrated such that the flocculant concentration in the sediment flow in the flume was 0.15g/L.

Oscillating Grid Assembly

Argaman and Kauffman (1971) showed that the maximum size of the flocs was controlled by the root mean square velocity gradient, G (sec^{-1}). The G value is determined by the kinetic energy that is dissipated by the mixing devices. The equation for determining the G value is as below:

$$G = \sqrt{\frac{\varepsilon}{\vartheta}}$$

where, ε (m^2/sec^3) is the kinetic energy dissipated, and ϑ is the kinematic viscosity of the fluid (m^2/s). The kinetic energy dissipated by the mixing device is dependent on the drag force and the relative mean velocity between the mixing device and the fluid (Liem et al., 1999).

$$\varepsilon = \frac{U_R F_d}{\rho V}$$

where, U_R is the relative mean velocity between the mixing device (m/s) and the fluid, F_d is the drag force (kg-m/s^2), ρ is the density of the fluid, and V is the volume of the fluid (m^3) that is mixed in one cycle. The drag force depends upon the relative mean velocity of the area of the grid, and is given by the equation (Liem et al., 1999)

$$F_d = \frac{1}{2} {U_R}^2 C_d A_s \rho$$

Here C_d is the coefficient of drag. It is determined based on the grid geometry and the rod Reynolds number (R_d) (Colomer et al., 2005). The equations that determine the coefficient of drag and the Reynolds number are:

$$C_d = 1 + 10{R_d}^{-2/3}$$

$$R_d = \frac{U_R d}{\vartheta}$$

Here d is the diameter of the rods of the grid (m). Thus, from the above equations we can see that the greater the drag force, the greater the energy dissipated and the greater the value of G. Higher values of G correspond to greater mixing intensities.

Therefore, in an oscillating grid-type mixing device, the frequency of oscillation was used to control the speed of the grids, and thus the drag force. By controlling the drag force we can control the G value, and thus estimate the floc sizes for different combinations of grid geometry and grid speeds, and thus optimize the flocculation parameters. The oscillating grid apparatus consisted of a DC motor with speed controller, chain and sprocket drive, cams, linear guides for the grids to move up and down smoothly, and the grid. The oscillating grid assembly had nine individual grids. The mesh size of each grid is 1/2 inch, and the rod diameter is 5mm. The individual grid assembly consisted of three grids each as shown in Figure 8. The grids were oscillated at two different speeds of 99 rpm and 148 rpm each.

Flume

The flume dimensions are 30ft X ½ ft X 1 ½ ft (L X W X H). The flume sampling ports on one side shown in Figure 9. The sampling ports are placed at a distance of 3 inches, 6 inches and 9 inches from the bottom of the flume. Only the top (9 inches) and the bottom ports (3 inches) at six stations were used for sampling. The stations, numbered from 1 to 6, were located a distance of 1.5, 6.5, 12.5, 19.5 and 27.5 ft from the start of the flume. Pitot tubes were fixed at each sampling ports facing upstream in the center of the flume.

Acoustic Doppler Velocitimeter

A Sontek/YSI, Inc. 16 MHz Acoustic Doppler Velocitimeter (ADV) was used to measure the turbulent velocity profiles at the downstream end of the oscillating grids to get additional information on the turbulence.

Figure 1. Soil separator.

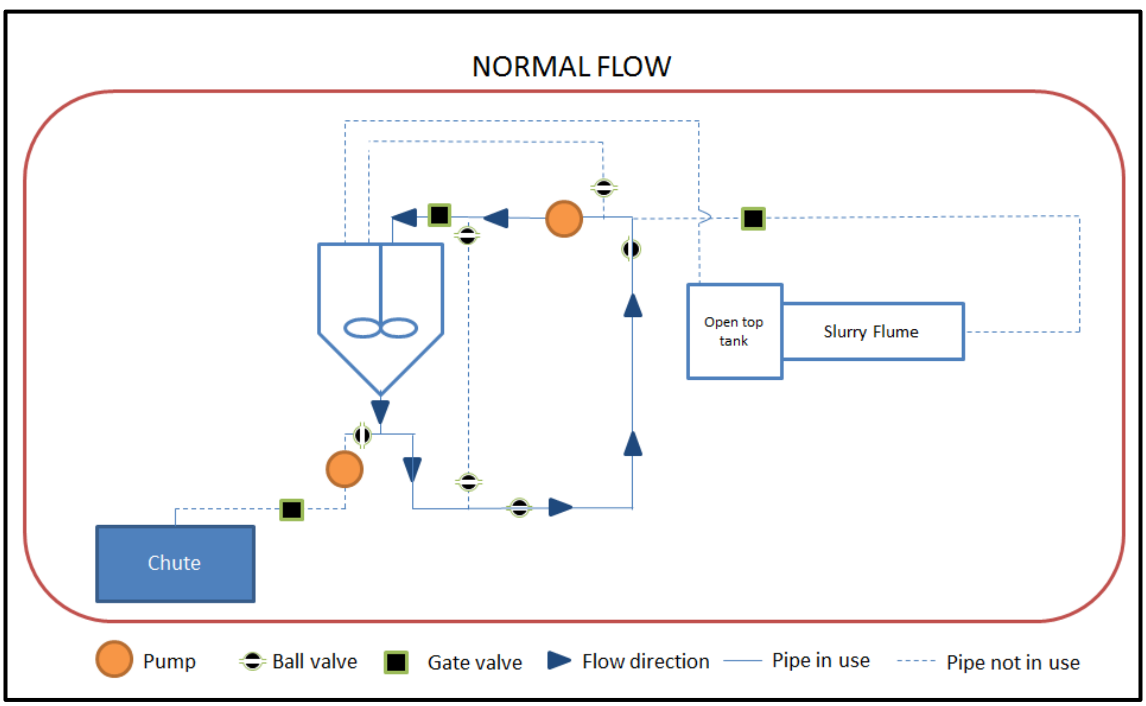

Figure 2. Normal Flow operation.

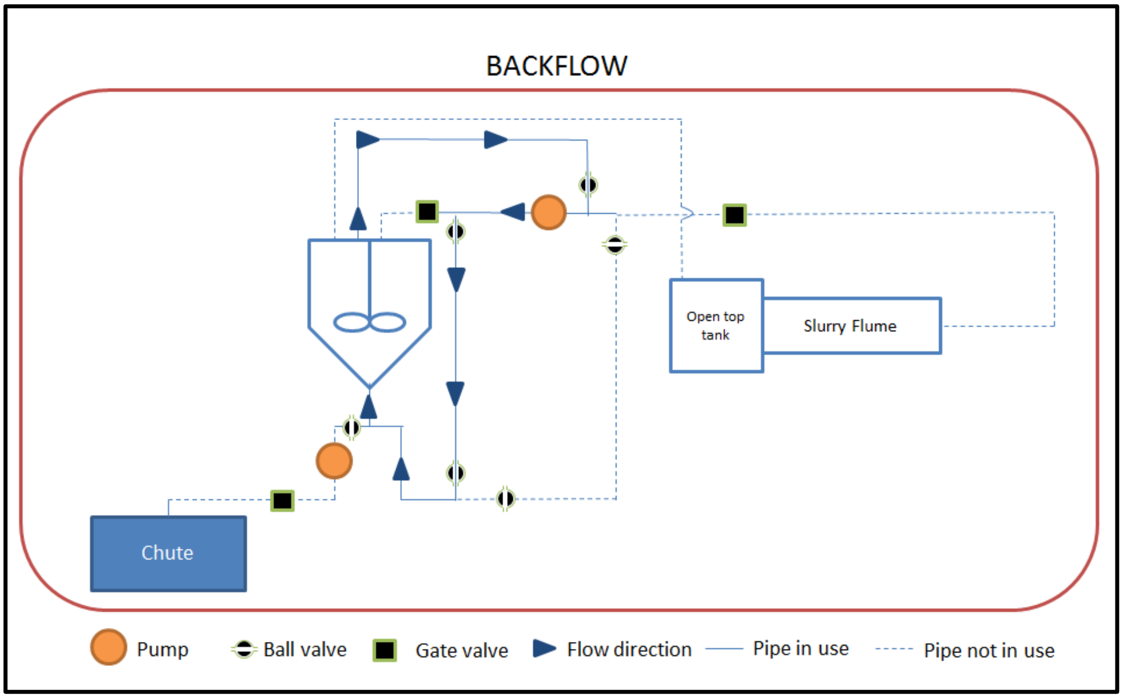

Figure 3. Back flow operation.

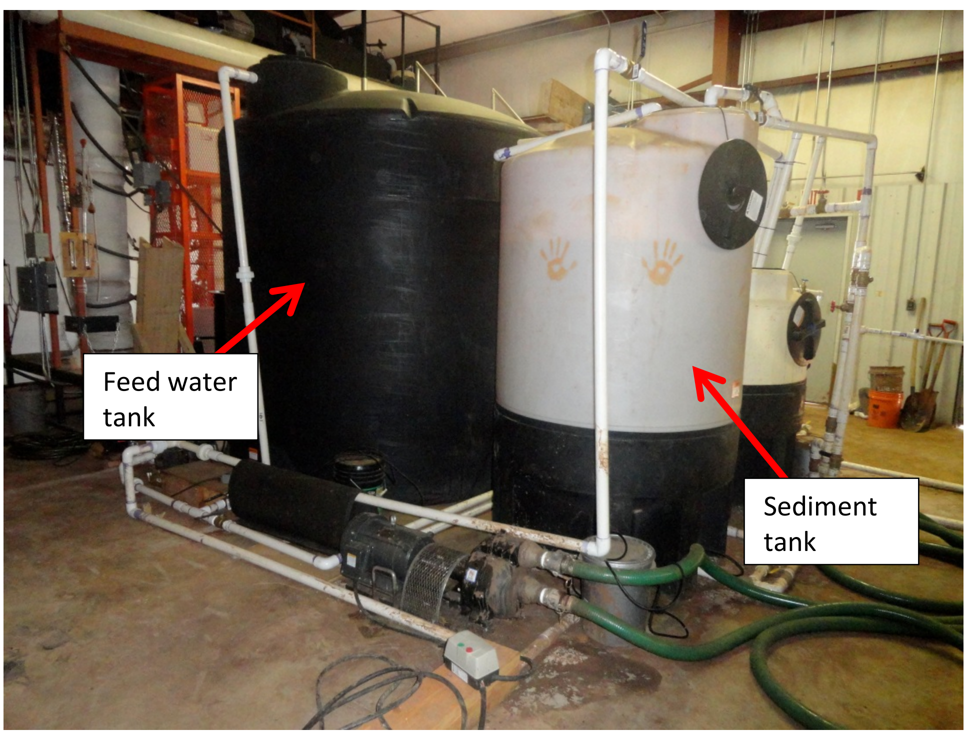

Figure 4. Soil injection system with the normal and back flow plumbing.

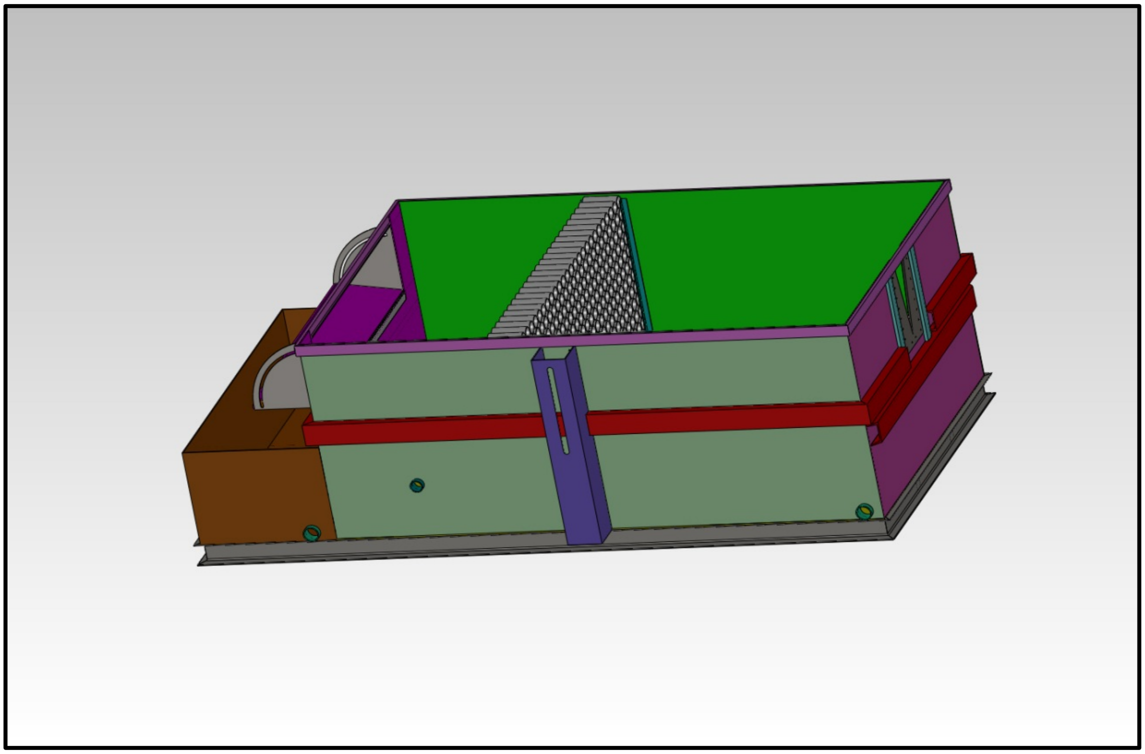

Figure 5. Diagram of the constant head tank.

Figure 6. Constant head tank as constructed.

Figure 7. Flume flocculant injection system.

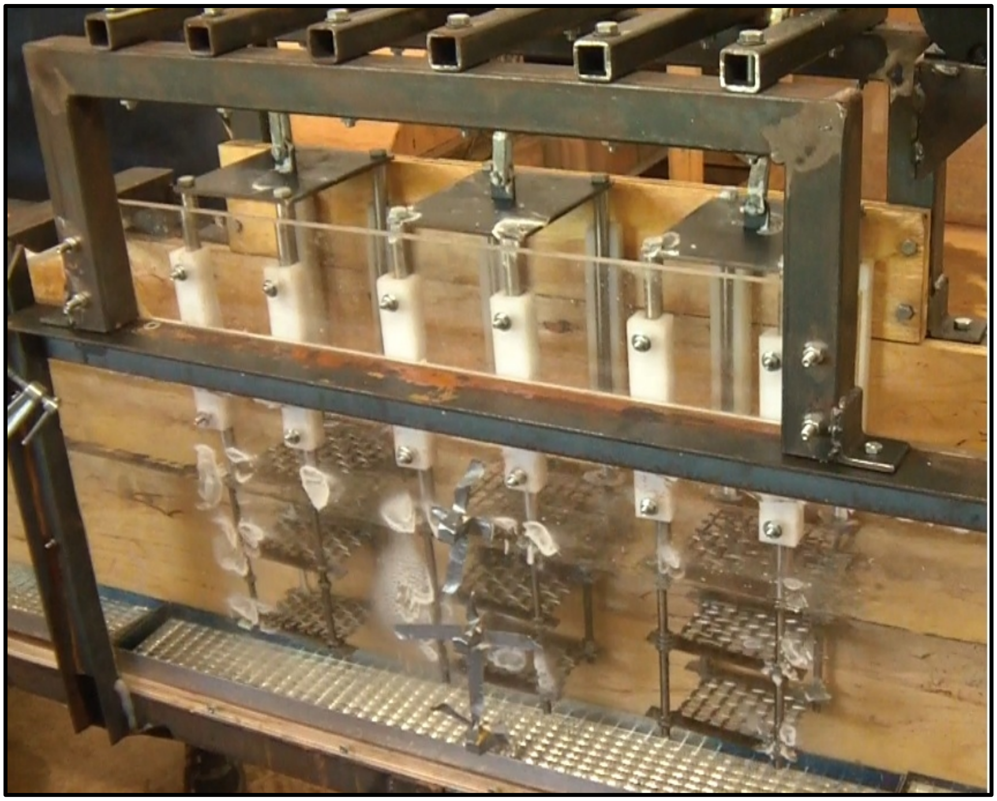

Figure 8. Oscillating grid assembly

Figure 9. Flume apparatus used for determination of flocculation constants.

Description of the Experimental Runs

Each experiment had a duration of approximately 10 minutes. Due to the slope on the flume, the tailgate height was fixed to ensure that the top port at Station 1 remained immersed in water throughout the experiment. During the experiment, the depth of the water at every station was measured. A sample of the sediment was collected at the injection port to determine the suspended sediments introduced into the system. Turbidity meters were installed at the upstream, and the downstream end of the flume. The sediment flow was controlled based on the upstream turbidity such that it was maintained in the range of 1500-2000 NTU, and it was continuously monitored throughout the experiment. Samples were at 1-minute interval in 250 ml bottles from the six stations, and the tailgate from the top and the bottom port simultaneously. Samples were collected from odd numbered station at time intervals of 1, 3, 5...etc. minutes and even samples were collected from the even numbered station at 2, 4, 6..etc. minutes. The first sample was collected from all stations and the tailgate at 0 minute. The Acoustic Doppler velocitimeter was used to measure the turbulent velocity at a location of 10 ft. from the start of the flume. Four types of runs conducted on each soil. The nature of each run was as follows:

Control Run without Agitation

In this run no flocculant was added to the sediment. No turbulence was introduced by the oscillating grids. The purpose of this run was to find out mass of the sediment that settled without the addition of any flocculant.

Low Velocity Gradient Control Run

In this run, no flocculant was added but the oscillating grids were oscillated at a low speed of 99rpm, which corresponds to a velocity gradient of 104 sec^{-1}. As additional turbulence and mixing is induced to the sediment flow because of the grids, lesser settling was expected from this run compared to that in the control run without agitation. The average mass that settled during this run was be used to calculate the actual mass that flocculated for the low velocity gradient flocculation runs.

High Velocity Gradient Control Run

In this run, no flocculant was added, but the oscillating grids were oscillated at a high speed of 148 rpm, which corresponds to a velocity gradient of 134 sec^{-1}. The average mass that settled during these runs was be used to calculate the actual mass that flocculated for the high velocity gradient flocculation runs.

Low Velocity Gradient Flocculation Run

The flocculant was dosed at a constant rate, and the grids were oscillated at a low speed of 99 rpm, which corresponds to a velocity gradient of 104 sec^{-1}. The speed of the oscillating grids was maintained constant for all the low velocity gradient flocculation runs.

High Velocity Gradient Flocculation Run

Similar to the low velocity gradient run, the flocculant dosage was held constant, and the grids were oscillated at a speed of 148rpm, which corresponds to a velocity gradient of 134 sec^{-1}.

Low and high velocity gradient flocculation runs were performed in triplicates in order to compare these data, check for the repeatability, and get a better estimation of the stickiness coefficient. The control runs were conducted in duplicates to compare and check for similarity in the trend of these data.

Flocculation Model

The Krishnappan and Model of Flocculation and Density

Krishnappan and Marsalek (2002) modeled flocculation for a stormwater detention pond. The model starts with a geometric progression for particle volumes, with resulting particle sizes, particle volumes, and particle volume ranges given in Table 1. This progression of particle sizes is such that all particle interactions for Bin *i* for particle classes *j* = 1 to *i*-1 will form flocs with an average diameter that will go to either Bin *i* or Bin *i*+1 (Figure 10). The Krishnappan and Marsalek approach to modeling flocculation assumes that all destabilized primary clay sized particles are in particle bin 1 with a characteristic particle diameter and particle volume. The number of collisions between particle from bin *j* (the source) with those from Bin *i* depends on the two particle sizes and turbulence characteristics. If *i* is the bin number for the target particle and *j* is the bin number for the source particle, the number of collisions per unit time for the two particle sizes is equal to a loss of particles from Bin *j* and a gain for Bin *i.* The rate at which particle interactions are occurring between particles in Bin *i* and Bin *j*, $N_{ij,t}$ (No. collisions/ft^3-sec) is:

$$N_{ij,t} = n_{i,t} K_{ij}^{eff} n_{j,t}$$

Where $n_{i,t}$ and $n_{j,t}$ (number/ft^3) are the number concentrations of flocs in Bins *i* and *j* and K_{ij}^{eff} (ft^3/sec) is the flocculation constant given by equation. K_{ij}^{eff} is the resultant collision frequency calculated as the weighted sum of the collision frequencies due to the four mechanisms: Brownian motion, turbulent shear, inertia of turbulent flow, and differential settling. The equations for the collision frequency of each mechanism and the effective collision frequency are as shown below:

$$Brownian\ Motion: K_{i,j}^{Kh,B} = \frac{2}{3}\frac{B_Z T}{\rho \nu}\frac{\left(r_i + r_j\right)^2}{r_i r_j}$$

$$Turbulent\ \ Shear: K_{i,j}^{Kh,SH} = \frac{4}{3}\left(\frac{\varepsilon}{\nu}\right)^{0.5}\left(r_i + r_j\right)^3$$

$$Inertia\ \ of\ \ Turbulent\ \ flow: K_{i,j}^{Kh,IN} = 1.21\frac{\rho_{sj}}{\rho_j}\left(\frac{\varepsilon^3}{\nu^5}\right)^{0.25}\left(r_i + r_j\right)^2 abs\left(r_i^2 - r_j^2\right)$$

$$Differential\ \ Settling: \ K_{i,j}^{Kh,DS} = \frac{2\pi g}{9\nu}\frac{\rho_{sj} - \rho_w}{\rho_w}\left(r_i + r_j\right)^2 abs\left(r_i^2 - r_j^2\right)$$

$$Effective\ collision\ \ frequency: K_{i,j}^{eff} = K_{i,j}^{Kh,BR} + \sqrt{\left(K_{i,j}^{Kh,Sh}\right)^2 + \left(K_{i,j}^{Kh,IN}\right)^2 + \left(K_{i,j}^{Kh,DS}\right)^2}$$

Multiplying $N_{ij,t}$ by the coagulation constant β (dim), the fraction of interactions that become flocs, one obtains the number of flocs of sizes *i* and *i*+1 that are being formed from the interactions of $n_{i,t}$ and $n_{j,t}$ flocs. Based on the distribution of particle sizes shown in Table 1, when a particle of size j interacts with particle *i, j<i,* and flocculates, there are two options for its destination. It either goes to particle Bin *i* or *i*+1. The fraction of particles going into Bin *i* or *i*+1, based on a mass balance, and is:

$$\rho_{si} n_i v_i + \rho_{sj} n_j v_j = \rho_{si} n_{Psi} v_i + \rho_{s,i+1} n_{Ps,i+1} v_{i+1}$$

Where ρ_{si} and $\rho_{s,i+1}$ (slugs/ft^3) are the densities of the floc sizes *i* and *j* respectively and $n_{ps,i}$ and $n_{ps,i+1}$ are the number of flocs going to Bins *i* and *i*+1. The above equation can be solved for the fraction of particles going to each bins *i* and *i+1*, f_{ij} and $f_{i+1,j}$ are:

$$f_{ij} = \frac{\rho_{si} v_i + \rho_{sj} v_j - \rho_{s,i+1} v_{i+1}}{\rho_{si} v_i - \rho_{s,i+1} v_{i+1}}$$

and:

$$f_{i+1,j} = 1 - f_{i,j}$$

where ρ_s is the density of flocs. We will return to the issue of floc density subsequently.

The rate of change of floc numbers, n_i (number/ft^3), in a given bin *i* is determined by subdividing the process into three components:

1. The rate of loss of particles in Bin *i* due to effective collisions with larger flocs in bins *j; j,* ≤ *j*, or:

$$\begin{bmatrix} ROL \\ to\,\text{larger} \\ sizes \end{bmatrix} = \left.\frac{dn_i}{dt}\right|_{[LBiFILP]} = -\sum_{j=i}^{N_{\max}} \beta_i K_{ij}^{eff} n_i n_j$$

Where $\beta_{i/j}$ (dim) is the so-called stickiness coefficient given by equation:

$$\beta_{i/j} = \alpha_o \left(1 - \frac{R_{i/j}}{S_{N_{\max}} + 1}\right)^n$$

Where N_{max} is the total number of flocculation bins for the given simulation, α_o (dim) is the true stickiness coefficient which must be determined for each soil and flocculent, n is an empirical constant (may be variable; Krishnappan suggests a value of 6), $R_{i/j}$ is the number of primary particles in Bin *i/j*, and S_{Nmax} is the maximum number of primary particles that can exist in a floc.

2. Rate of gain (ROG) from collisions with smaller particles (GBiFISP), i.e., *j≤i.*

$$\begin{bmatrix} ROG\ from \\ smaller\ floc\, sizes; \\ i.e.,\ i \geq j \end{bmatrix} = \left.\frac{dn_i}{dt}\right|_{[GBiFISP]} = \sum_{j=1}^{i} \beta_i f_{ij} K_{ij}^{eff} n_i n_j$$

3. Rate of gain from floc formation in Bin *i-1* (GBiFBi-1) resulting in flocs that are larger than those in Bin *i -1* and there transferred (diffused) to Bin *i*.

$$\begin{bmatrix} ROG\ from\ \ floc \\ formation\ from \\ bins\ contributing \\ to\, Bin\ i-1 \end{bmatrix} = \left.\frac{dn_i}{dt}\right|_{[GBiFBi-1]} = \sum_{j=1}^{i-1} \left(1 - f_{i-1,j}\right) \beta_{i-1} K_{i-1,j}^{eff} n_{i-1} n_j$$

In order to do a mass balance such that the total rate of change of primary particles (clay particles) summed over all bins, it is necessary to convert equations to rates of change of primary particles.

- The total loss of primary particles from Bin *i*. If we define the rate of loss of primary particles from Bin *i* as $\left. dn_{pp,i} / dt \right|_{[LBiFILP]}$, then the total loss of primary particles from Bin *i* becomes:

$$\begin{bmatrix} ROL\ primary \\ particles\, to \\ larger\ size\ flocs \end{bmatrix} = \left.\frac{dn_{pp,i}}{dt}\right|_{[LBiFILP]} = -\sum_{j=i}^{N_{max}} 2^{i-1} \beta_i K_{ij}^{eff} n_i n_j$$

  where 2^{i-1} is the number of primary particles per floc in Bin *i*.

- Rate of gain of primary particles from interactions with Bins *j ≤ i*. The source bin in this case will be Bin *j*, thus:

$$\begin{bmatrix} ROG\,of\ \ pp\ \ from \\ smaller\ \ floc\,sizes; \\ i.e.,\ i \geq j \end{bmatrix} = \left.\frac{dn_{pp,i}}{dt}\right|_{[GBiFISP]} = \sum_{j=1}^{i} 2^{j-1} \beta_i f_{ij} K_{ij}^{eff} n_i n_j$$

- Rate of gain of primary particles from floc formation in Bin *i*-1 (GBiFBi-1) resulting in flocs that are larger than those in Bin *i* -1 and then transferred (diffused) to Bin *i*. The source bin in this case is still Bin *j,* thus:

$$\begin{bmatrix} ROG\,of\,pp\,from\ \ floc \\ formation\,in\,Bin\ \ i-1 \\ that\ \ diffuses\,to\,Bin\,i \end{bmatrix} = \left.\frac{dn_{pp,i}}{dt}\right|_{[GBiFBi-1]} = \sum_{j=1}^{i-1} 2^{j-1} \left(1 - f_{i-1,j}\right) \beta_{i-1} K_{i-1,j}^{eff} n_{i-1} n_j$$

- The total rate of gain or loss of the particles in bin i,j is given as:

$$\begin{bmatrix} ROC \\ n_{pp,i} \end{bmatrix} = \begin{bmatrix} ROL\ primary \\ particles\,to\,larger \\ size\ \ flocs, i.e., i \leq j \end{bmatrix} + \begin{bmatrix} ROG\,of\ \ pp\ \ from \\ smaller\ \ floc\,sizes; \\ i.e.,\ i \geq j \end{bmatrix} + \begin{bmatrix} ROG\,of\,pp\,from\ \ floc \\ formation\,in\,Bin\ \ i-1 \\ that\,diffuses\,to\,Bin\,i \end{bmatrix}$$

$$\frac{dn_{pp,i}}{dt} = \left.\frac{dn_{pp,i}}{dt}\right|_{[LBiFILP]} + \left.\frac{dn_{pp,i}}{dt}\right|_{[GBiFISP]} + \left.\frac{dn_{pp,i}}{dt}\right|_{[GBiFBi-1]}$$

and

$$\frac{dn_{pp,i}}{dt} = -\sum_{j=i}^{N_{\max}} 2^{i-1} \beta_j K_{ij}^{eff} n_i n_j + \sum_{j=1}^{i} 2^{j-1} \beta_i f_{ij} K_{ij}^{eff} n_i n_j + \sum_{j=1}^{i-1} 2^{j-1} \left(1 - f_{i-1,j}\right) \beta_{i-1} K_{i-1,j}^{eff} n_{i-1} n_j$$

Returning now to the issue of particle density, Krishnappan and Marsalek (2002) developed the following empirical relationship for particle density:

$$\rho_{s,i} - \rho_w = \left(\rho_{s,1} - \rho_w\right) \exp\left(-b d_i^c\right)$$

where $\rho_{s,i}$, ρ_w , and $\rho_{s,1}$ (slugs/ft^3) are the densities of floc of size *i*, water, and the characteristic primary clay particle, *i*=1, of diameter $d_{s,1}$ and *b,* and *c* are empirical constants. Dividing both sides of the equation by ρ_w, the equation is converted to a relationship for specific gravity, SG_i (dim), or:

$$\frac{SG_i - 1}{SG_1 - 1} = \exp\left(-bd_{\mu,i}^{c}\right)$$

where $d_{\mu,i}$ is in microns. Since we work in the ft-lb-sec system, we must convert d_i (ft) to $d_{\mu,i}$ using:

$$d_{\mu,i} = 3.04 * 10^5 d_i$$

Krishnappan and Marsalek (2002) suggest values of 0.02 and 1.45 for b and c when using diameters in microns.

Table 1. Particle and floc size distribution methodology for the bins in the flocculation model.

Bin No.	1	2	3	4	..	*M*
Particle Diameter Mean	d_1	1.26 d_1	$1.59d_1$	$2d_1$	..	$\left[\frac{2^{M-1}}{3}\right]d_1$
Particle Volume Mean	v_1	$2v_1$	$4v_1$	$8v_1$	..	$2^{M-1}v_1$
Particle Volume Range	$2/3v_1$ to $4/3v_1$	$4/3v_1$ to $8/3v_1$	$8/3v_1$ to $16/3v_1$	$16/3v_1$ to $32/3v_1$	..	$\frac{2^M}{3}v_1$ to $\frac{2^{M+1}}{3}v_1$

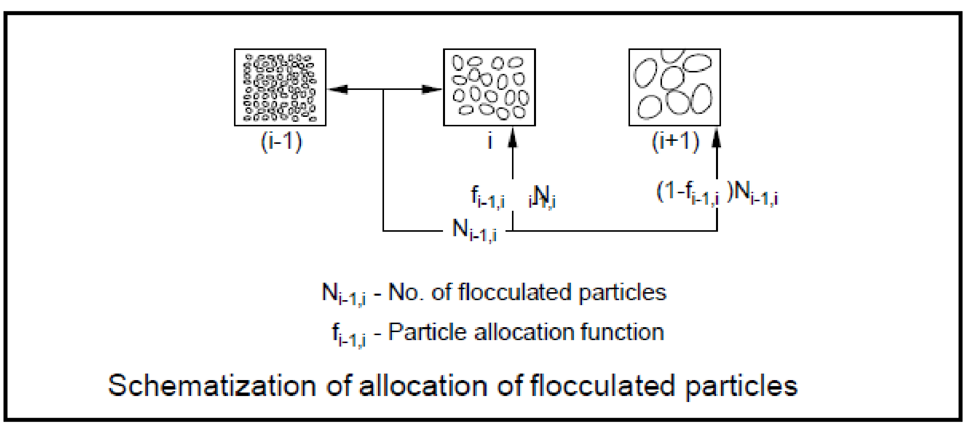

Figure 10. Schematic of method used for partitioning flocculated particles

Spreadsheet Description and Assumptions

This section will discuss how the constants were determined using spreadsheets and the associated assumptions.

Description of the Spreadsheet

As mentioned in the Flocculation Model section, the Krishnappan Model was used to model flocculation. A spreadsheet was developed to solve the flocculation routine of this model, and determine the number of flocs formed at any given time. The assumptions made to determine the constants using the spreadsheet were as follows:

1. The flume was divided into two sections: mixing chamber and settling chamber.

2. The total duration of the experiment was 15 minutes (900 seconds) on an average.

The mixing time was the retention time of the sediments, which was calculated as the length of the mixing chamber (3 ft) divided by the velocity of the flow. Therefore, the mixing time was determined as 15 seconds. The settling time was equal to 885 seconds, which was the remainder time of the duration of the experiment.

Determination of Turbulent Energy Dissipation Rate ε

The turbulent energy dissipation rates in the mixing chamber are higher than that in the settling chamber due to the oscillations induced by the grids. The turbulent energy dissipation rates for the mixing chamber were determined using the oscillating grids equations. The turbulent energy dissipation rate for low speed and high-speed oscillations was different. For Low speed the value of **ε** was 0.13 ft^2/sec^3, and for high speed it was 0.217 ft^2/sec^3. The value for the turbulent energy dissipation rate for the settling chamber was determined as shown in the section below.

The turbulent energy dissipation rate for the settling chamber was determined using the relationship as shown in Figure 11 (Nakayama and Yokojima, 2003). Table 2 shows the values of the turbulent energy dissipation rate calculated for a velocity of 0.2 ft/s for the settling chamber. Since the value of the turbulent energy dissipation rate Ɛ was assumed the average, the value of all the above calculated values and was 0.0005 ft^2/sec^3.

Determination of the Radius, Volume, and Density of the flocs

The radius of the flocs was calculated using the equation:

$$r_f=r_i*2^{(i-1/3)}$$

The flocs were assumed to be perfectly spherical, and the volume of the flocs was determined using the equation of the volume of the sphere. The density of the flocs was determined using the following equation:

$$\rho_{s,i} - \rho_w = \left(\rho_{s,1} - \rho_w\right)\exp\left(-bd_i^c\right)$$

Since the equation is empirical, the diameter of the flocs was in microns, and density was computed in g/cm^3, which was then converted to slugs/ft^3.

Determination of the fraction of the flocs

The fraction of the flocs settling in the higher bins was calculated using the equation as shown below.

$$f_{ij} = \frac{\rho_{si}v_i + \rho_{sj}v_j - \rho_{s,i+1}v_{i+1}}{\rho_{si}v_i - \rho_{s,i+1}v_{i+1}}$$

Determination of the collision frequencies

The collision frequencies depend on the turbulent energy dissipation rate. Therefore, during the first 15 seconds of the simulation where the sediments get mixed in the mixing chamber, the values of collision frequencies correspond to the ε value of the mixing chamber (Low speed= 0.13 ft^2/sec^3, High speed=0.217 ft^2/sec^3). During the second half of the simulation the value of ε is changed to that for the settling chamber (0.0005 ft^2/sec^3), and the values of the collision frequency changed accordingly. Collision frequency due to Brownian motion was set to zero assuming that its effect is negligible. Effective collision frequencies were calculated to take into account the effect of the three mechanisms, and were used to solve the flocculation equation. For all the simulations, the collisions were assumed to occur to all the mechanisms simultaneously, thus the effective collision frequency was used for all the calculations.

Determination of the equivalent radius of the clay particles

Equivalent diameter was used to represent the size of the primary particles. The equivalent diameter was determined using the Stokes law. The average settling velocity for the particles was found to be 0.000246 ft/sec. With this value, the equivalent diameter of the primary particles was found to be 9 microns.

Determination of the constants using the flocculation equation

The equation used to solve the mass balance was as follows:

Mass injected=Mass that settles without flocculation + flocculated mass + unflocculated mass

The proportion of the sediment that settled without flocculation (small aggregates and silt) was determined from the control run with agitation. The same proportion of mass was subtracted from the total mass that was trapped in the trays at the end of each flocculation run to determine the mass that settled due to flocculation. Finally, predicted flocculated mass was compared with the measured flocculated mass to determine the value of the stickiness coefficient α.

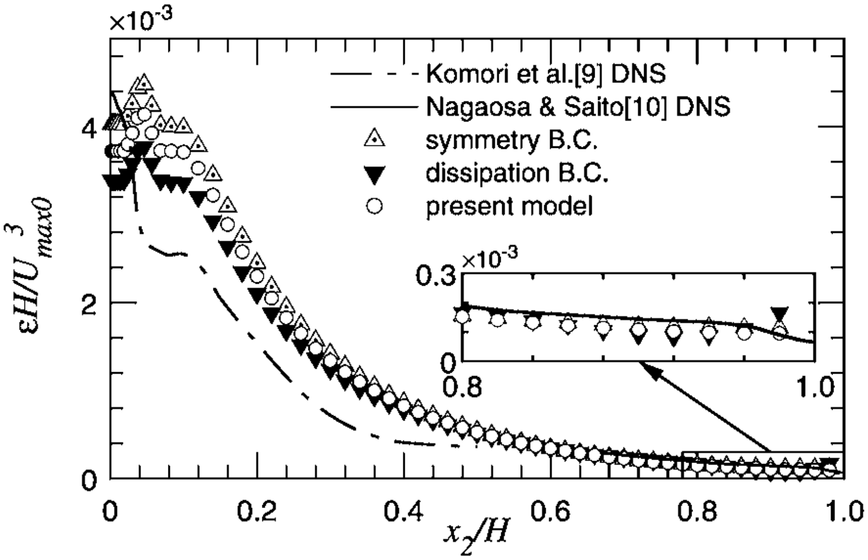

Figure 11. Turbulent energy dissipation rate for fully-developed open channel and duct flows

Table 2. Values of Energy dissipation rates calculated for the settling chamber from Figure 14.

X_2/H	$\varepsilon H/U^3$	ε (ft2/sec)
0.04	0.008	0.0016
0.08	0.005	0.001
0.12	0.0025	0.0005
0.16	0.0018	0.00036
0.2	0.0016	0.00032
0.4	0.001	0.0002
0.6	0.0003	0.00006
0.8	0.0001	0.00002
1	0.00005	0.00001

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Turbidity –Suspended Sediment Concentration Modeling

<u>Model Development</u>

Soil texture is composed of primarily particles (sand, silt and clay), small aggregates and large aggregates. There are not any standard methods to determine fraction of small aggregates and large aggregates for parent soil sample. In addition to this, particle size analysis has been done with dispersed soil to determine fraction of sand, silt and clay only. Neglecting the effects of small and large aggregates, a hypothesis has been made that the fraction and size distribution of primary particles in the soil sample affects the turbidity. The sand, silt and clay fraction were determined (discussed later) from dispersed soil sample. For dispersed soil, two predictive relationships between turbidity and suspended sediment concentration (SSC) have been developed. First one is - linear relationship between turbidity and SSC, which is called linear model hereafter. Turbidities due to each suspended sediment particles classes (sand, silt and clay) are defined as,

$$T_{sa}= k_{1L}[sa];\ T_{si}= k_{2L}[si] \text{ and } T_{cl} = k_{3L}[cl] \qquad (1)$$

where T_{sa}, T_{si} and T_{cl} are turbidities due to sand, silt and clay in (NTU); [sa],[si] and [cl] are concentrations of sand , silt and clay respectively; k_{1L}, k_{2L} and k_{3L} are turbidity coefficients for sand, silt and clay in linear model.

Similarly, second predictive relationship is defined as non-linear power function (called power model hereafter) between turbidity and each SSC particles classes, which were formulated as,

$$T_{sa}= k_{1P}\ [sa]^{a}\ ;\ T_{si}= k_{2p}[si]^{b} \text{ and } T_{cl} = k_{3p}[cl]^{c} \qquad (2)$$

where, k_{1P}, k_{2P} and k_{3P} are turbidity coefficients for sand, silt and clay in power model. Similarly, a, b and c are turbidity exponent in power model. The turbidity of dispersed soil is summation of turbidities due to each primary suspended sediment particles,

$$T_{dis} = T_{sa} + T_{si} + T_{cl} \qquad (3)$$

where T_{dis} is turbidity for dispersed soil sample in NTU.

<u>Separation of Sand, Silt and Clay</u>

For this study, five parent soil samples of Oklahoma were provided by Oklahoma Department of Transportation. Kamie B, Norge B, Stepehville B, Port A and Port B soils were collected in Oklahoma. About 2-3 kg of air dried parent soil was collected using classical coning and quartering method for homogeneous mix. Sample was then sieved through a 2 mm opening, ASTM No. 10 Sieve [*ASTM*, 2013]. The sample passing through sample is composed of sand, silt and clay. As per *ASTM* [2007], the sample was soaked with 125 ml sodium hexametaphosphate (SHMP) solution (40 g/l concentration) per 50 g of soil sample for 16 hours. The SHMP is a dispersing agent. After soaking period, sample was sieved through No. 270 sieve (53 µm opening). The passing through sample was portion of silt and clay. During sieving process, 40 g/l SHMP solution was used to maintain constant concentration in silt and clay slurry. The retained sample (sand) on the No. 270 sieve was washed with Reverse Osmosis (RO) water and made SHMP free. The sand portion was oven dried at 90^{o}c to constant mass in pre weighted polypropylene jars in order to avoid burning or chemical composition change of organics or minerals present in the sample as well as jars. The organics and minerals present in the soil sample might affect the turbidity of soil sample, therefore a lower temperature than the *ASTM* [2007] recommendation was used for sample dry. The soil passed through No. 270 sieve was portion of silt and clay according to USDA classification (50 µm, cutoff for silt and clay).

Since separation of silt and clay cannot separate by sieve analysis, centrifugation method was utilized to separate the silt and clay. Beckman GP centrifuge[*Beckman Instruments*, 1988] was used. Four 750 ml bottles were used for centrifuge. The soil slurry passed through No. 270 was filled into four centrifuge bottles. The centrifuge run time (1 min 42 sec) was estimated as 1 min 42 sec based on rotor's specifications of *Beckman Coulter* [2007] and using the relationship developed by *Hathaway* [1956]. The centrifuge was run with soil slurry passed through No. 270 sieve. After run time, bottles were carefully removed from the centrifuge one by one and about 80 % of the supernatant was decanted from each bottles and transferred to pre weighted polypropylene jars for oven dry at 90^{o}c to constant mass which was the portion of clay. The decanted portion of clay included SHMP (40 g/l concentration) which made a hard cluster after dry. Clay and SHMP were broken up using grinder and final product was powdered clay and SHMP. SHMP concentration was recorded in each soil sample. The remaining 20 % soil slurry in the centrifuge bottles was mainly silt fraction, few clay and SHMP. Sufficient amount of RO water was filled into bottles and mixed thoroughly and centrifuge run was repeated to 13 times which made a reasonably clear suspension in the bottles .The remaining soil slurry on the centrifuge bottle was silt and water only which is free from SHMP as well. The silt slurry was transferred to pre weighted polypropylene jars for oven dry at 90^{o}c to constant mass.

<u>Turbidity Measurement: determining turbidity constants</u>

Turbidities were measured for each primary particle (sand, silt and clay) for each soil using Hach Hydrolab MS5 Sonde (called turbidity meter hereafter). This turbidity meter can measure turbidity up to 3000 NTU if properly calibrated. Turbidity meter was calibrated using Hach company's turbidity standard in 4 points (1, 100, 1000 and 3000 NTUs). The calibration makes linear between two points (for example between 100 and 1000). Ranges of concentration were selected for clay, silt and sand in each type of soils. The concentration were 50, 100, 200, 400, 800, 1600, 3200 and 4000 mg/l. In order to get turbidity constants (equation 1 and 2) for clay, sand and silt for each parent soils, turbidities were measured with concentrations ranging from 50 mg/ to 4000 mg/l as listed above. One liter beaker placed over magnetic stirrer plate. The beaker was filled up with 750 ml RO water. To determine clay turbidity constants, known concentrations (50 to 4000 mg/l) of clay (adjusted with SHMP content) were put into the beaker and continuously stirred with magnetic stirrer at constant speed in order keep solution in suspension. The SHMP content on the clay portion doesn't affect the turbidity because there were no difference for turbidity between RO water and SHMP solution. The turbidity probe was inserted into the sample beaker as per turbidity meter specifications and turbidity readings were recorded every minute up to 15 readings. The first 5 minute were considered as mixing time and median of last 5 minute readings were considered as turbidity of the sample. For quality control, all measurements were at least duplicates. If second set of turbidity measures were way off (with in error range of turbidity meter), third set of measurement were conducted. The process was repeated for all concentrations (each clay, sand and silt fraction) of all five soils. Linear and non-linear (power) regression analysis were performed for turbidity vs. primary particles concentration of all five soils. The turbidity constants and powers were determined based on equation 1 and 2 for clay silt and sand for all five soils. To test the model (equation 3), turbidity were measured for a range of combinations of sand, silt and clay for each soil. The sand, silt and clay combinations were random which ranged from 250 to 5000 mg/l concentration in total. For example; 48 mg of sand, 240 mg of silt and 212 mg makes 500 mg of mix. There were total 16 such combinations for each soil types. The relationship between turbidity-SSC (equation 3) was tested using turbidity constants obtained by regression analysis with random combinations of sand, silt and clay fractions for all five soils.

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Results

Quantification of flocculation constants for five Oklahoma soils

The five Oklahoma soils analyzed for this portion of the study were Port A-horizon (hereafter referred to as Port A), Port B-horizon (hereafter referred to as Port B), Kamie B-horizon (hereafter referred to as Kamie B), Stephenville B-horizon (hereafter referred to as Stephenville B) and Norge B-horizon ((hereafter referred to as Norge B). Besides testing our methods on a soil from Oklahoma, this analysis also provides insight into the impact depth of excavation has on flocculation properties. The following section presents all the data collected and analyzed after conducting the flume experiments on all the five soils. The section is divided into four main sections

1. Data Analysis on Port A soil
2. Data Analysis on Port B soil
3. Data Analysis on Kamie B soil
4. Data Analysis on Norge B soil
5. Data Analysis on Stephenville B soil

Each individual sections describe the detailed results obtained for both control and the flocculation runs performed on the soils.

<u>Data Analysis for Port A</u>

In the following section, data for the suspended sediment concentration, and the flocculation constants for the Port A soil were presented. Table 3 gives a summary of experimental runs done on Port A soil.

<u>Port A Control Run without Agitation (C1)</u>

Tables 4 to 10 show the concentration of the suspended sediment measured in the top and bottom ports at the six stations and the tailgate. Figure 12 shows the graph of the suspended sediment concentration in the top and bottom ports. The X-axis of the graph shows the time interval which the sample was collected. Table 11 shows the mass of the sediments that settled in the trays at the bottom of the flume.

Since this was the control run, and no flocculant is added it can be seen that the average sediment concentration is more or less constant at every station at all the sampling intervals. Figure 13 shows the graph of the measured turbidity at the upstream and downstream end of the flume. It can be seen from the turbidity plot that the average downstream turbidity is slightly less compared to the upstream turbidity. This can be attributed to the mass of the sediment that settles down without having the requirement of flocculant to cause settling.

Table 3. Summary of the experimental runs for Port A. [ND: no data measured NA: Not applicable]

Run No.	Description	Oscillation Speed (rpm)	Velocity Gradient (sec^{-1})	Sediment Flow Rate (L/min)	Incoming Sediment (g/L)	Water Flow Rate (L/min)	Flocculant (g/L)
C1	Control run without agitation	0	1.57	39.4	10.8	168.2	NA
C2	Low velocity gradient control run	99	104	59.0	11.3	170	NA
C3	High velocity gradient control run	148	134	26.8	12.8	170	NA
C4	Low velocity gradient control run	99	104	11.0	23.3	170	NA
C5	High velocity gradient control run	148	134	13.1	23.1	170	NA
C6	Control run without agitation duplicate	0	1.57	13.93	21.0	170	NA
F1	Low velocity gradient flocculation run	99	104	17.5	ND	170	0.15
F2	High velocity gradient flocculation run	148	134	34.0	11.4	186	0.15
F3	Low velocity gradient flocculation run duplicate	99	104	25.5	14.5	170	0.15
F4	High velocity gradient flocculation run duplicate	148	134	14.4	24.32	186	0.15
F5	Low velocity gradient flocculation run triplicate	99	104	11.7	24.66	186	0.15
F6	High velocity gradient flocculation run triplicate	148	134	11.3	21.6	170	0.15

Table 4. Suspended solids in control run without agitation C1 for Station 1. ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4626	26.3146	26.9110	26.7621	0.4484	0.4475	1.7936	1.7900
2	26.2504	26.3816	26.6854	26.8244	0.4350	0.4428	1.7400	1.7712
3	26.2693	26.3963	26.7070	26.8413	0.4377	0.4450	1.7508	1.7800
4	26.2931	26.3136	26.7323	26.7628	0.4392	0.4492	1.7568	1.7968
5	26.2949	26.5036	26.7240	26.9500	0.4291	0.4464	1.7164	1.7856
6	26.2954	26.2846	26.7291	26.7244	0.4337	0.4398	1.7348	1.7592

Table 5. Suspended solids in control run without agitation C1 for Station 2. ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3448	26.3244	26.7540	26.7519	0.4092	0.4275	1.6368	1.7100
2	26.4730	26.4083	26.8982	26.8476	0.4252	0.4393	1.7008	1.7572
3	26.4460	26.5211	26.8733	26.9516	0.4273	0.4305	1.7092	1.7220
4	26.4140	26.3678	26.8534	26.7997	0.4394	0.4319	1.7576	1.7276
5	26.3521	26.2910	26.7844	26.7411	0.4323	0.4501	1.7292	1.8004
6	26.4137	26.5778	26.8417	27.0162	0.4280	0.4384	1.7120	1.7536

Table 6. Suspended solids in control run without agitation C1 for Station 3. ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3621	26.4037	26.7786	26.7990	0.4165	0.3953	1.6660	1.5812
2	26.4320	26.4319	26.8453	26.7979	0.4133	0.3660	1.6532	1.4640
3	26.2625	26.2793	26.6789	26.6908	0.4164	0.4115	1.6656	1.6460
4	26.3240	26.3056	26.7249	26.7196	0.4009	0.4140	1.6036	1.6560
5	26.3352	26.4842	26.7565	26.9009	0.4213	0.4167	1.6852	1.6668
6	26.2780	26.3201	-	-	-	-	-	-

Table 7. Suspended solids in control run without agitation C1 for Station 4. ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3543	26.4755	26.7501	26.8771	0.3958	0.4016	1.5832	1.6064
2	26.3166	26.3117	26.7270	26.7226	0.4104	0.4109	1.6416	1.6436
3	26.3107	26.3434	26.7134	26.7574	0.4027	0.414	1.6108	1.6560
4	26.3046	26.4157	26.7319	26.8203	0.4273	0.4046	1.7092	1.6184
5	26.4514	26.3493	26.8645	26.7703	0.4131	0.4210	1.6524	1.6840
6	26.4136	26.2934	26.8321	26.7265	0.4185	0.4331	1.6740	1.7324

Table 8. Suspended solids in control run without agitation C1 for Station 5. ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2852	26.4155	26.6495	26.7897	0.3643	0.3742	1.4572	1.4968
2	26.4204	26.4044	26.8534	26.8398	0.4330	0.4354	1.7320	1.7416
3	26.4870	26.3100	26.9073	26.7301	0.4203	0.4201	1.6812	1.6804
4	26.4410	26.2688	26.8785	26.6890	0.4375	0.4202	1.7500	1.6808
5	26.3283	26.2424	26.7681	26.6840	0.4398	0.4416	1.7592	1.7664
6	26.4390	26.2711	26.8854	26.7029	0.4464	0.4318	1.7856	1.7272

Table 9. Suspended solids in control run without agitation C1 for Station 6. ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4170	26.3145	26.7625	26.6839	0.3455	0.3694	1.382	1.4776
2	26.3460	26.3271	26.7344	26.7324	0.3884	0.4053	1.5536	1.6212
3	26.2924	26.2857	26.6815	26.6923	0.3891	0.4066	1.5564	1.6264
4	26.3388	26.4632	26.7260	26.8701	0.3872	0.4069	1.5488	1.6276
5	26.3736	26.4755	26.7671	26.8794	0.3935	0.4039	1.5740	1.6156
6	26.4747	26.3888	26.8653	26.7911	0.3906	0.4023	1.5624	1.6092

Table 10. Suspended solids in control run without agitation C1 for tailgate. ('-' indicates No data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.2961	26.5658	0.2697	1.0788
2	26.3826	26.7733	0.3907	1.5628
3	26.2967	26.6941	0.3974	1.5896
4	26.4762	26.8796	0.4034	1.6136
5	26.4123	26.8067	0.3944	1.5776
6	26.5098	26.9098	0.4000	1.6000

Table 11. Mass of the settled sediment in the trays for the control run without agitation C1.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.35	395.40	2.05
2	790.00	798.25	8.25
3	792.20	799.95	7.75
4	786.40	796.75	10.35
5	787.40	797.65	10.25
6	789.95	801.35	11.40
7	393.25	402.70	9.45
8	786.75	796.90	10.15
9	868.80	877.80	9.00
10	1223.00	1234.05	11.05
11	1179.65	1191.55	11.90

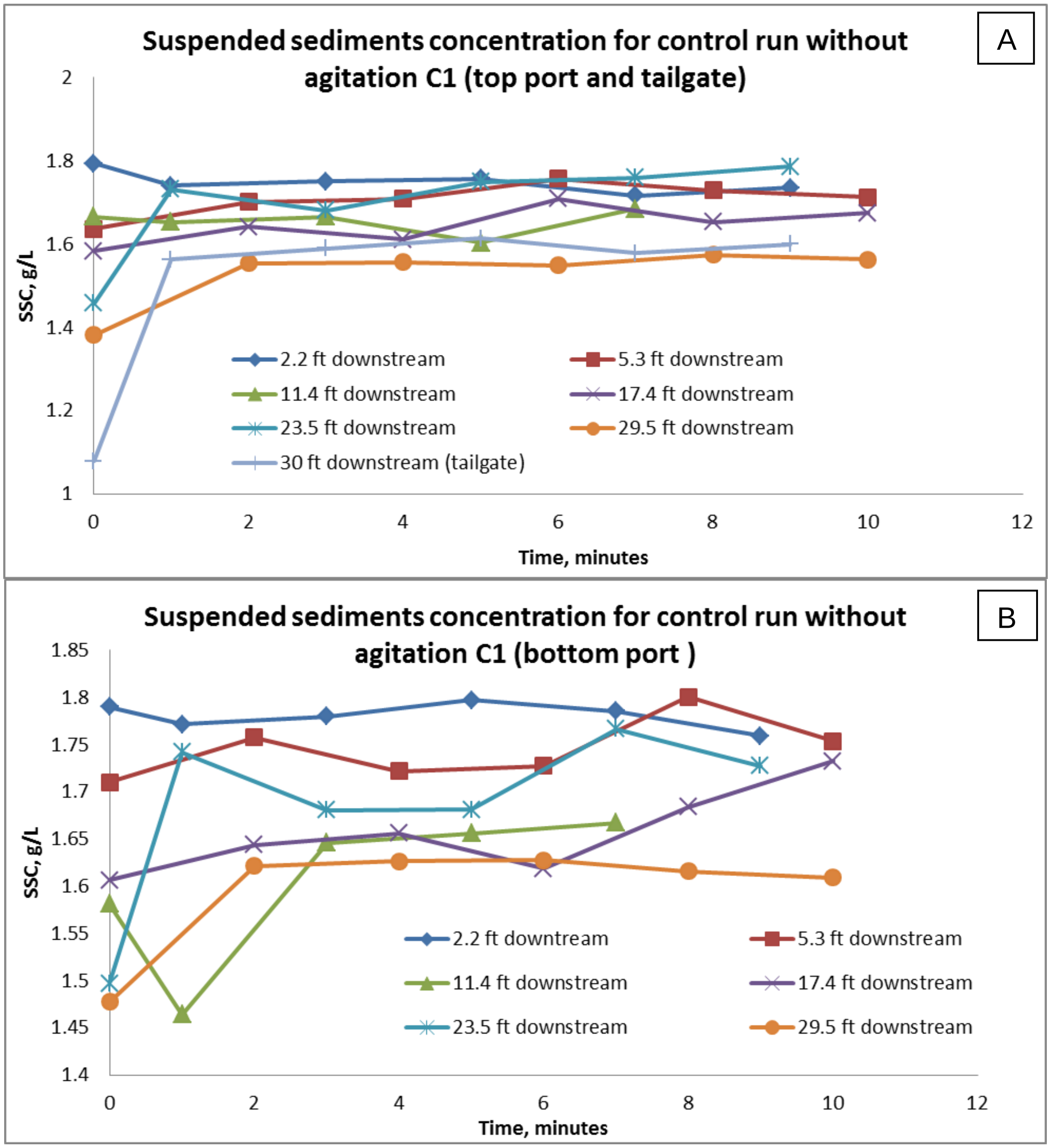


Figure 12. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

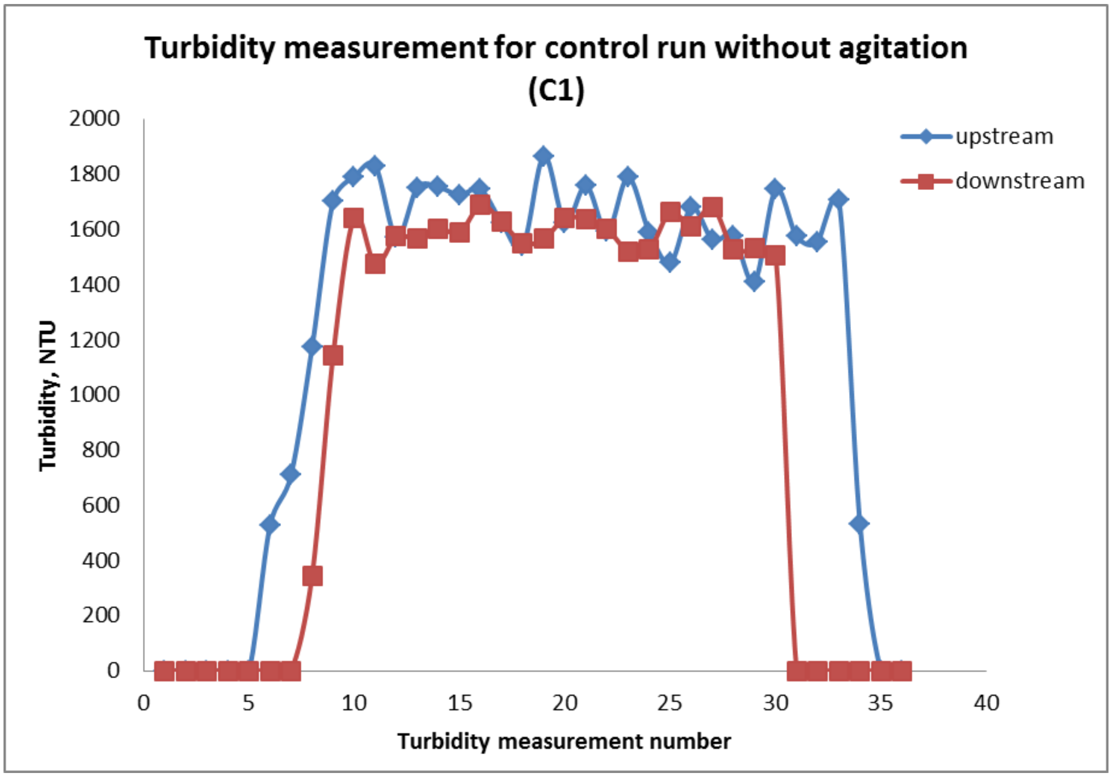


Figure 13. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30 second time duration after which the turbidity reading was recorded by the instrument.

Port A Low Velocity Gradient Control Run (C2)

The speed of the oscillating grids was set at 99 rpm for this control run, which corresponds to a velocity gradient of 104 sec^{-1}. Tables 12 to 18 shows the suspended sediment concentration, and Table 19 shows the mass of the sediment that settled in the trays. Figure 14 shows the graph of the concentration of the suspended matter measured at all the sampling ports. Figure 15 shows the graph of the upstream and downstream turbidity measured throughout the run.

Table 12. Suspended sediment concentration for low velocity gradient control C2 at Station 1('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2719	26.3655	26.6931	26.7859	0.4212	0.4204	1.6848	1.6816
2	26.5149	26.3893	26.9374	26.8088	0.4225	0.4195	1.6900	1.6780
3	26.4539	26.3283	26.8684	26.7474	0.4145	0.4191	1.658	1.6764
4	26.2572	26.3570	26.6828	26.7858	0.4256	0.4288	1.7024	1.7152
5	26.2972	26.3875	26.7111	26.8150	0.4139	0.4275	1.6556	1.7100
6	26.4456	26.3460	26.8677	26.7837	0.4221	0.4377	1.6884	1.7508

Table 13. Suspended sediment concentration for low velocity gradient control C2 at Station 2('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2651	26.2944	26.6471	26.6810	0.3820	0.3866	1.5280	1.5464
2	26.5093	26.5030	26.9297	26.9211	0.4204	0.4181	1.6816	1.6724
3	26.4491	26.2741	26.8632	26.6978	0.4141	0.4237	1.6564	1.6948
4	26.2188	26.3636	26.6257	26.7030	0.4069	0.3394	1.6276	1.3576
5	26.3122	26.4364	26.7224	26.8430	0.4102	0.4066	1.6408	1.6264
6	26.3097	26.4913	26.7338	26.9254	0.4241	0.4341	1.6964	1.7364

Table 14. Suspended sediment concentration for low velocity gradient control C2 at Station 3 ('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3273	26.5096	26.7332	26.9093	0.4059	0.3997	1.6236	1.5988
2	26.2888	26.3950	26.6488	26.7685	0.3600	0.3735	1.4400	1.4940
3	26.4299	26.4626	26.8301	26.8675	0.4002	0.4049	1.6008	1.6196
4	26.4115	26.4981	26.8163	26.9012	0.4048	0.4031	1.6192	1.6124
5	26.4932	26.4187	26.9043	26.8312	0.4111	0.4125	1.6444	1.6500
6	26.4327	26.3961	26.8053	26.7575	0.3726	0.3614	1.4904	1.4456

Table 15. Suspended sediment concentration for low velocity gradient control C2 at Station 4 ('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3051	26.2880	26.6943	26.6828	0.3892	0.3948	1.5568	1.5792
2	26.3330	26.2936	26.7342	26.7055	0.4012	0.4119	1.6048	1.6476
3	26.3990	26.3144	26.7929	26.7161	0.3939	0.4017	1.5756	1.6068
4	26.4915	26.4930	26.8920	26.9025	0.4005	0.4095	1.6020	1.6380
5	26.3429	26.2454	26.7387	26.6568	0.3958	0.4114	1.5832	1.6456
6	26.4202	26.4233	26.8361	26.8367	0.4159	0.4134	1.6636	1.6536

Table 16. Suspended sediment concentration for low velocity gradient control C2 at Station 5 ('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2806	26.3947	26.6572	26.7781	0.3766	0.3834	1.5064	1.5336
2	26.2958	26.3083	26.6970	26.6974	0.4012	0.3891	1.6048	1.5564
3	26.4440	26.5051	26.8513	26.8944	0.4073	0.3893	1.6292	1.5572
4	26.4233	26.3815	26.8240	26.7828	0.4007	0.4013	1.6028	1.6052
5	26.5339	26.2516	26.9408	26.6636	0.4069	0.4120	1.6276	1.6480
6	26.5226	26.3931	26.9326	26.8146	0.4100	0.4215	1.6400	1.6860

Table 17. Suspended sediment concentration for low velocity gradient control C2 at Station 6 ('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3657	26.3017	26.7337	26.6685	0.3680	0.3668	1.4720	1.4672
2	26.4072	26.3061	26.7911	26.6965	0.3839	0.3904	1.5356	1.5616
3	26.5080	26.2903	26.9033	26.6947	0.3953	0.4044	1.5812	1.6176
4	26.3063	26.2719	26.6394	26.6369	0.3331	0.3650	1.3324	1.4600
5	26.4575	26.4941	26.8241	26.9115	0.3666	0.4174	1.4664	1.6696
6	26.3634	26.4335	26.7499	26.8388	0.3865	0.4053	1.5460	1.6212

Table 18. Suspended sediment concentration for low velocity gradient control C2 at tailgate ('-' indicates no data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment conc g/L
1	26.4958	26.8056	0.3098	1.2392
2	26.3316	26.7082	0.3766	1.5064
3	26.3055	26.6971	0.3916	1.5664
4	26.3267	26.7055	0.3788	1.5152
5	26.4113	26.8001	0.3888	1.5552
6	26.3422	26.7246	0.3824	1.5296

Table 19. Mass of the sediment settled in the trays for low velocity gradient control C2.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.30	395.50	2.20
2	870.30	876.80	6.50
3	832.00	838.90	6.90
4	786.80	795.20	8.40
5	871.70	880.20	8.50
6	834.00	844.10	10.10
7	393.50	401.95	8.45
8	871.50	880.35	8.85
9	759.55	768.75	9.20
10	760.60	768.25	7.65
11	760.45	767.90	7.45

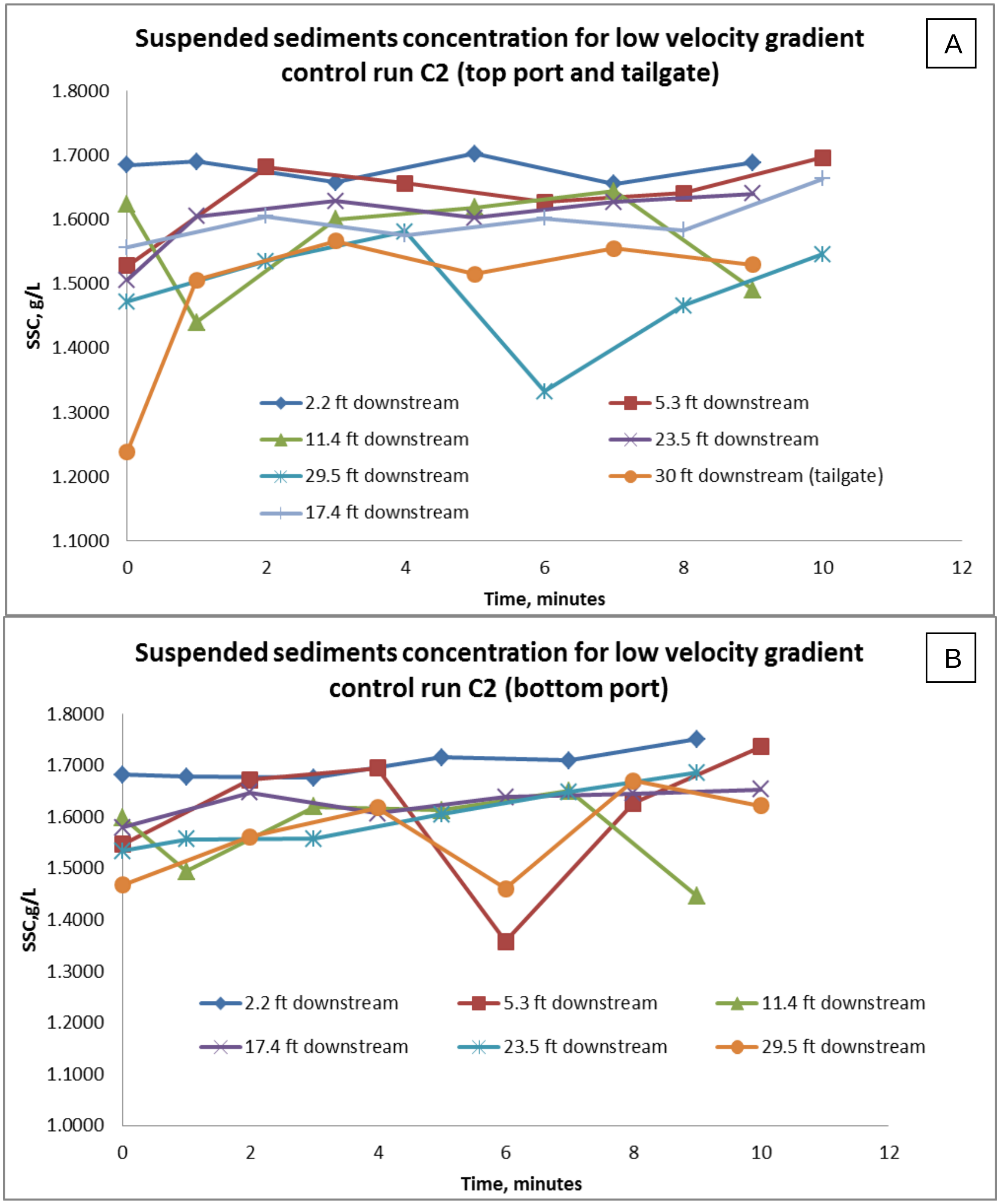


Figure 14. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

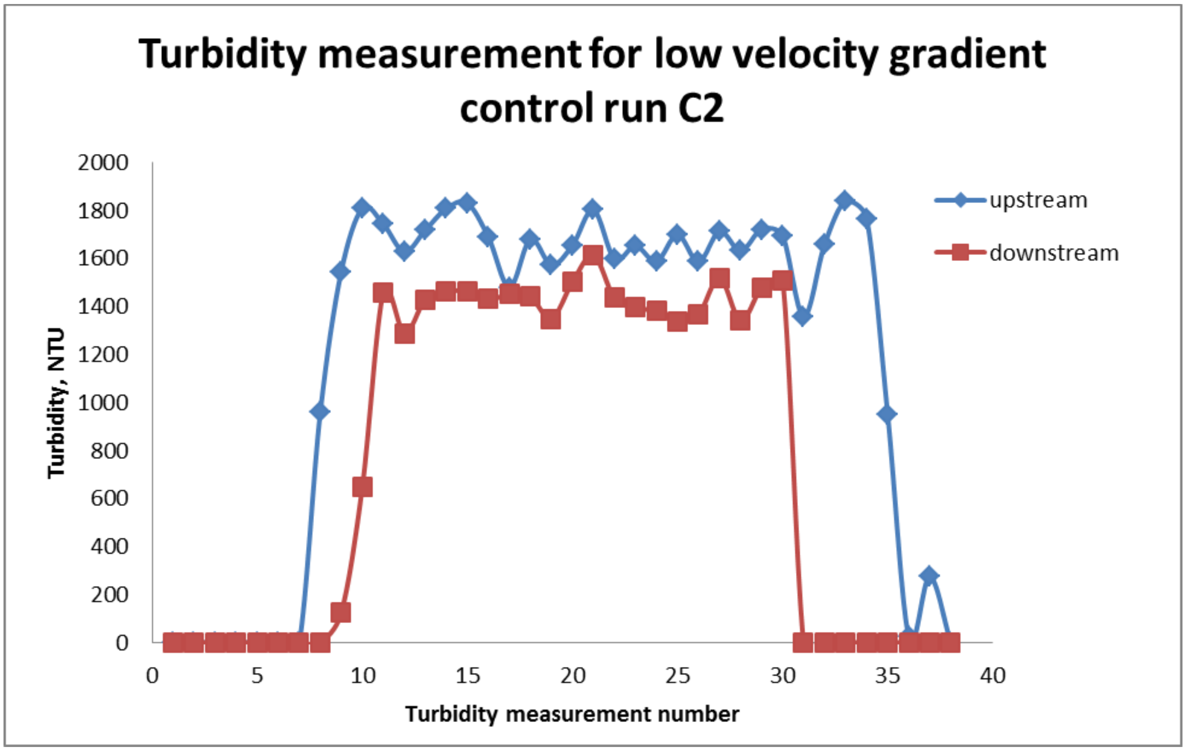


Figure 15. Upstream and downstream turbidity for low velocity gradient control run C2. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument..

Port A High Velocity Gradient Control Run (C3)

The speed of the oscillating grids was set at 148 rpm for this control run, which corresponds to a velocity gradient of 134 sec^{-1}. Tables 20-26 show the suspended sediment concentrations, and Tables 27 shows the mass of the sediment that settled in the trays. Figure 16 shows the graph of the concentration of the suspended matter measured at all the sampling ports. Figure 17 shows the graph of the upstream and downstream turbidity measured throughout the run.

Table 20. Suspended sediment concentration for high velocity gradient control run C3 at Station 1('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4955	31.3627	31.8755	31.7682	0.3800	0.4055	1.5200	1.6220
2	31.4490	31.4042	31.8483	31.8050	0.3993	0.4008	1.5972	1.6032
3	31.2300	31.5308	31.6369	31.9556	0.4069	0.4248	1.6276	1.6992
4	31.2394	31.1435	31.6531	31.5755	0.4137	0.4320	1.6548	1.7280
5	31.3896	31.3477	31.8039	31.7730	0.4143	0.4253	1.6572	1.7012
6	31.3585	31.4450	31.7769	31.8746	0.4184	0.4296	1.6736	1.7184

Table 21. Suspended sediment concentration for high velocity gradient control run C3 at Station 2('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3718	31.3488	31.7934	31.7723	0.4216	0.4235	1.6864	1.6940
2	31.4691	31.1816	31.8815	31.6012	0.4124	0.4196	1.6496	1.6784
3	31.3585	31.3957	31.7649	31.8273	0.4064	0.4316	1.6256	1.7264
4	31.4514	31.4583	31.8671	31.8760	0.4157	0.4177	1.6628	1.6708
5	31.3368	31.4126	31.7526	31.8375	0.4158	0.4249	1.6632	1.6996
6	31.4426	31.5048	31.8623	31.9226	0.4197	0.4178	1.6788	1.6712

Table 22. Suspended sediment concentration for high velocity gradient control run C3 at Station 3('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station3	T	B	T	B	T	B	T	B
1	31.3739	31.3654	31.7866	31.7780	0.4127	0.4126	1.6508	1.6504
2	31.2014	31.4348	31.6060	31.8366	0.4046	0.4018	1.6184	1.6072
3	31.4086	31.3766	31.8119	31.7790	0.4033	0.4024	1.6132	1.6096
4	31.3578	31.3840	31.7627	31.7885	0.4049	0.4045	1.6196	1.6180
5	31.4076	31.2064	31.8090	31.6123	0.4014	0.4059	1.6056	1.6236
6	31.4817	31.4754	31.8902	31.8772	0.4085	0.4018	1.6340	1.6072

Table 23. Suspended sediment concentration for high velocity gradient control run C3 at Station 4('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	31.3601	31.5266	31.7219	31.8925	0.3618	0.3659	1.4472	1.4636
2	31.5380	31.4162	31.9335	31.8177	0.3955	0.4015	1.5820	1.6060
3	31.3119	31.4579	31.7047	31.8781	0.3928	0.4202	1.5712	1.6808
4	31.4534	31.3828	31.8497	31.7890	0.3963	0.4062	1.5852	1.6248
5	31.3987	31.4049	31.7934	31.8086	0.3947	0.4037	1.5788	1.6148
6	31.3817	31.3706	31.7777	31.7860	0.3960	0.4154	1.5840	1.6616

Table 24. Suspended sediment concentration for high velocity gradient control run C3 at Station 5('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4728	31.2617	31.8628	31.6510	0.3900	0.3893	1.5600	1.5572
2	31.3773	31.4064	31.7793	31.8175	0.4020	0.4111	1.6080	1.6444
3	31.3810	31.3430	31.7799	31.7410	0.3989	0.3980	1.5956	1.5920
4	31.4026	31.4770	31.7960	31.8760	0.3934	0.3990	1.5736	1.5960
5	31.4040	31.3629	31.8011	31.7642	0.3971	0.4013	1.5884	1.6052
6	31.4021	31.4155	31.7968	31.8158	0.3947	0.4003	1.5788	1.6012

Table 25. Suspended sediment concentration for high velocity gradient control run C3 at Station 6('-' indicates no data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4328	26.5601	26.8493	26.9859	0.4165	0.4258	1.6660	1.7032
2	26.4971	26.5390	26.8374	26.9181	0.3403	0.3791	1.3612	1.5164
3	26.6734	26.6816	26.9629	27.1130	0.2895	0.4314	1.1580	1.7256
4	26.5372	26.5308	26.8945	26.8855	0.3573	0.3547	1.4292	1.4188
5	26.5051	26.5123	26.8891	26.9415	0.3840	0.4292	1.5360	1.7168
6	26.5897	26.6505	27.0401	27.0763	0.4504	0.4258	1.8016	1.7032

Table 26. Suspended sediment concentration for high velocity gradient control run C3 at tailgate ('-' indicates no data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment conc g/L
1	31.2196	31.5821	0.3625	1.4500
2	31.4642	31.8529	0.3887	1.5548
3	31.4534	31.8469	0.3935	1.5740
4	31.3517	31.7374	0.3857	1.5428
5	31.3804	31.7685	0.3881	1.5524
6	31.1489	31.5422	0.3933	1.5732

Table 27. Mass of the sediment settled in the trays for high velocity gradient control run C3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.20	395.30	2.10
2	789.70	796.35	6.65
3	786.25	796.90	10.65
4	789.60	799.65	10.05
5	786.50	798.00	11.50
6	791.65	803.80	12.15
7	393.10	405.50	12.40
8	827.70	840.15	12.45
9	1224.00	1235.30	11.30
10	1262.45	1276.15	13.70
11	827.20	837.75	10.55

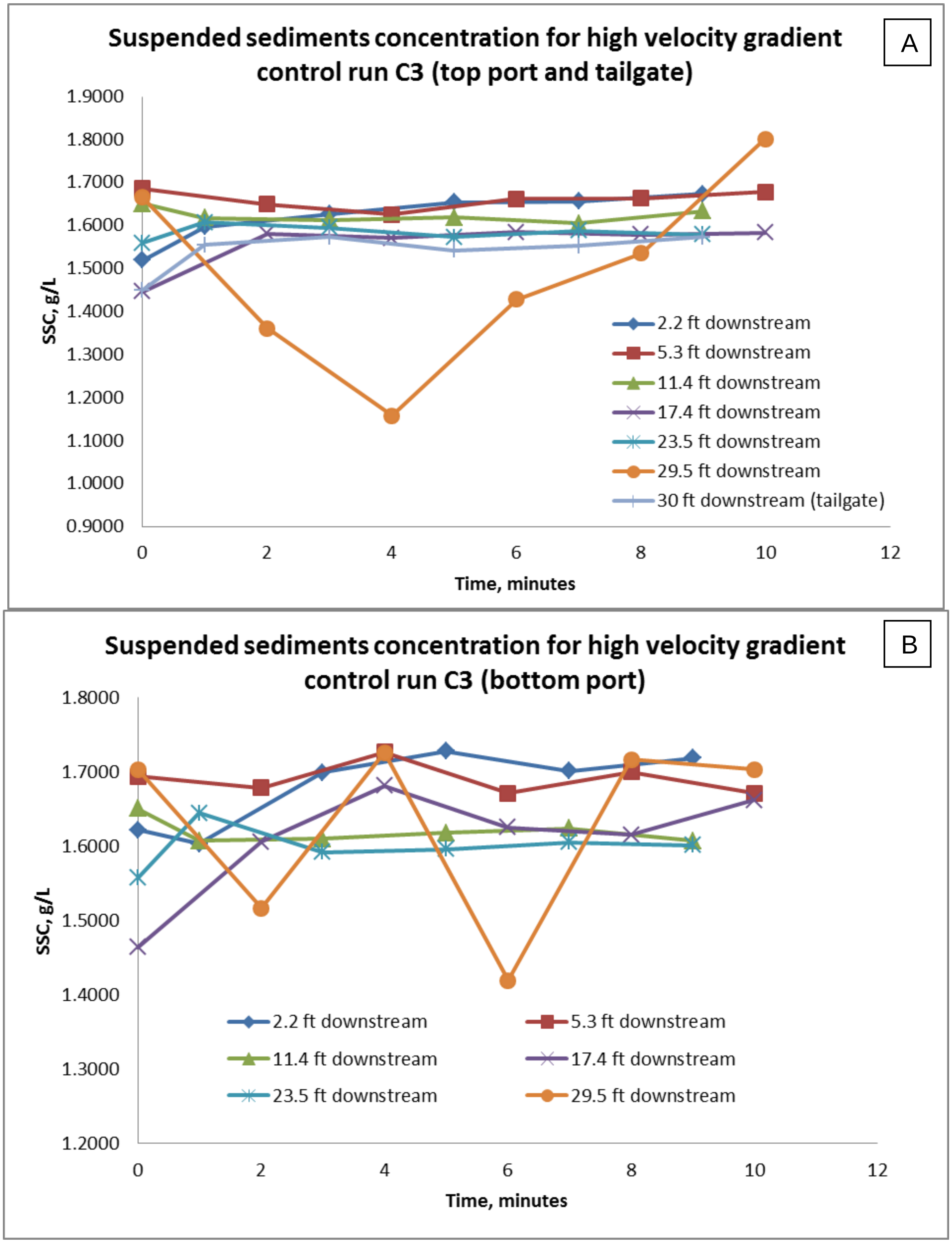


Figure 16. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

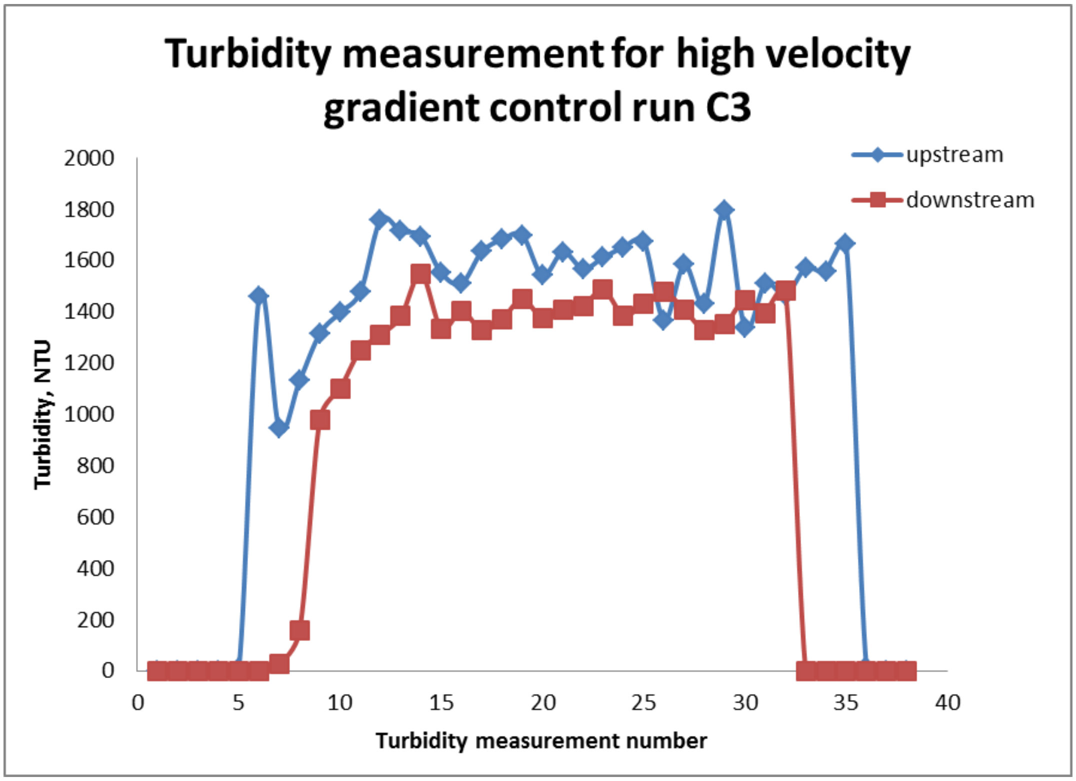


Figure 17. Upstream and downstream turbidity for high velocity gradient control run C3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port A Low Velocity Gradient Control Run duplicate (C4)</u>

The oscillating grid speed for this run was 99 rpm. Tables 28 to 34 show the concentration of the sediment measured at all the sampling stations, and Table 35 shows the mass of the sediment that settled in the trays. Figure 18 shows the graph of the suspended sediment concentration at all the sampling stations, and Figure 19 shows the graph of the upstream and downstream turbidity measured throughout the run. The soil pump tripped 4 minutes after the start of the run therefore, the flow of the sediment into the flume was interrupted for a duration of 1 minute. A low sediment concentration was measured at the top and the bottom ports at the 3rd and 4th minute interval, and the same effect can be seen in Figure 23.

Table 28. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 1 ('—' indicates No Data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5797	31.6584	31.8558	31.9068	0.2761	0.2484	1.1044	0.9936
2	31.5234	31.6566	31.7814	31.7899	0.2580	0.1333	1.0320	0.5332
3	31.6508	31.5854	31.5719	31.6799	--	0.0945	--	0.3780
4	31.4696	31.6698	31.5534	31.8387	0.0838	0.1689	0.3352	0.6756
5	26.3497	31.5248	26.7479	31.9226	0.3982	0.3978	1.5928	1.5912
6	26.4189	31.5909	26.8277	31.8660	0.4088	0.2751	1.6352	1.1004

Table 29. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 2 ('—' indicates No Data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2757	31.5773	26.6896	31.8729	0.4139	0.2956	1.6556	1.1824
2	31.4852	31.2523	31.8806	31.6476	0.3954	0.3953	1.5816	1.5812
3	26.1900	31.5164	26.3371	31.6189	0.1471	0.1025	0.5884	0.4100
4	31.3022	31.4876	31.6188	31.8501	0.3166	0.3625	1.2664	1.4500
5	26.3452	26.2603	26.7452	26.6894	0.4000	0.4291	1.6000	1.7164
6	31.5285	31.5402	31.8092	31.9289	0.2807	0.3887	1.1228	1.5548

Table 30. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 3 ('—' indicates No Data)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5259	31.4624	31.8616	31.8400	0.3357	0.3776	1.3428	1.5104
2	26.5233	31.5013	26.9097	31.8379	0.3864	0.3366	1.5456	1.3464
3	31.4718	31.5508	31.7106	31.8313	0.2388	0.2805	0.9552	1.1220
4	31.4639	26.4162	31.6371	26.7475	0.1732	0.3313	0.6928	1.3252
5	31.3828	26.2610	31.7369	26.6300	0.3541	0.3690	1.4164	1.4760
6	31.6963	31.2296	31.8683	31.6114	0.1720	0.3818	0.6880	1.5272

Table 31. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 4 ('—' indicates No Data)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5402	31.3075	31.7282	31.5939	0.1880	0.2864	0.7520	1.1456
2	26.4648	26.6138	26.8591	26.7525	0.3943	0.1387	1.5772	0.5548
3	31.4940	26.7120	31.5386	26.7833	0.0446	0.0713	0.1784	0.2852
4	26.3556	31.4158	26.7670	31.8205	0.4114	0.4047	1.6456	1.6188
5	26.3582	31.5804	26.7331	31.8681	0.3749	0.2877	1.4996	1.1508
6	26.6275	31.6650	26.8374	31.7950	0.2099	0.1300	0.8396	0.5200

Table 32. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 5 ('—' indicates No Data)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2654	26.2875	26.6326	26.6801	0.3672	0.3926	1.4688	1.5704
2	31.1637	31.5852	31.5252	31.8863	0.3615	0.3011	1.4460	1.2044
3	31.5175	31.5157	31.8655	31.8798	0.3480	0.3641	1.3920	1.4564
4	26.4943	31.4846	26.5193	31.5747	0.0250	0.0901	0.1000	0.3604
5	31.2872	31.4395	31.6181	31.8228	0.3309	0.3833	1.3236	1.5332
6	31.4129	31.4414	31.8081	31.8286	0.3952	0.3872	1.5808	1.5488

Table 33. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 6 ('—' indicates No Data)

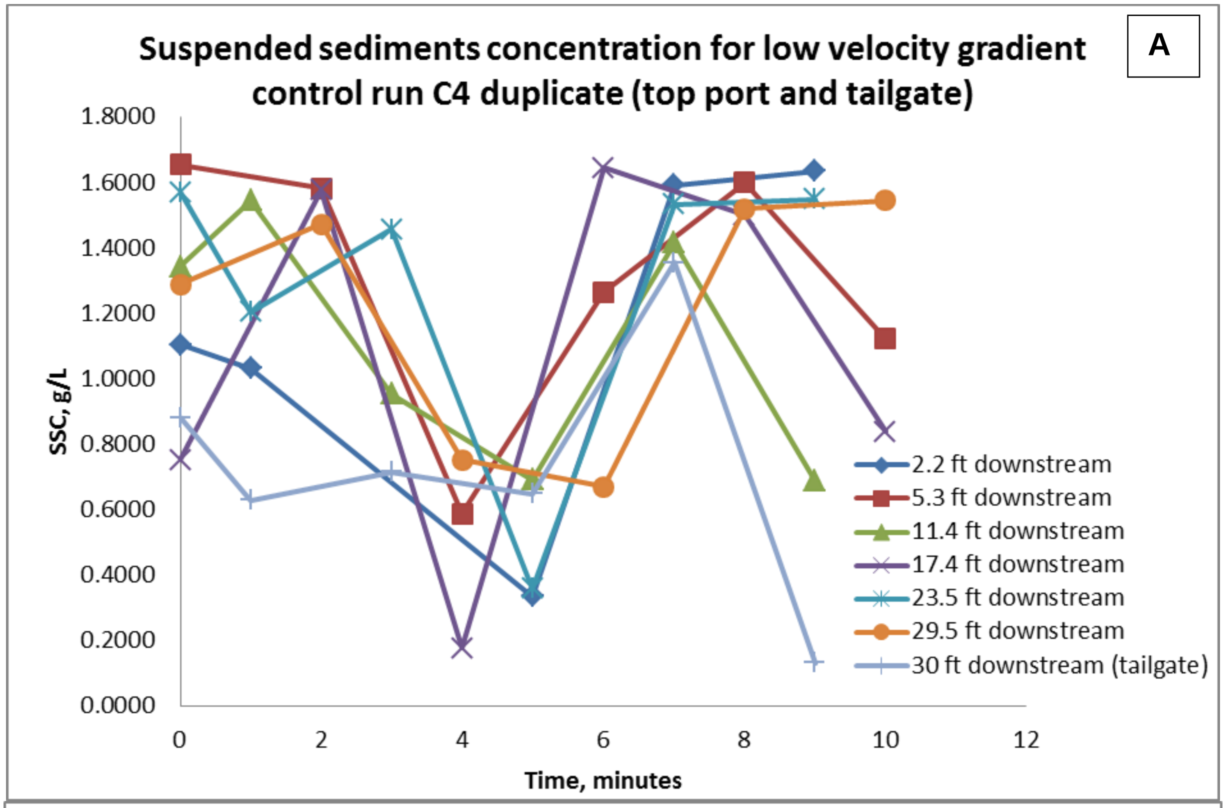
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3838	31.4006	26.7061	31.8063	0.3223	0.4057	1.2892	1.6228
2	31.5371	26.4317	31.9053	26.7820	0.3682	0.3503	1.4728	1.4012
3	31.4647	31.6821	31.6528	31.7731	0.1881	0.0910	0.7524	0.3640
4	31.2713	26.3095	31.4390	26.5542	0.1677	0.2447	0.6708	0.9788
5	26.3114	31.4884	26.6913	31.8733	0.3799	0.3849	1.5196	1.5396
6	26.4062	26.4883	26.7923	26.8873	0.3861	0.3990	1.5444	1.5960

Table 34. Suspended sediment concentration for low velocity gradient control run duplicate C4 at Station 6 ('—' indicates No Data)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment conc g/L
1	31.3835	31.6040	0.2205	0.8820
2	31.5107	31.6679	0.1572	0.6288
3	31.6762	31.8549	0.1787	0.7148
4	31.4895	31.6519	0.1624	0.6496
5	31.3842	31.7231	0.3389	1.3556
6	31.7830	31.8161	0.0331	0.1324

Table 35. Mass of the sediment settled in the trays for low velocity gradient control run duplicate C4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	436.80	439.55	2.75
2	870.70	877.80	7.10
3	830.85	839.15	8.30
4	828.25	838.60	10.35
5	828.70	839.55	10.85
6	830.45	842.25	11.80
7	787.05	798.85	11.80
8	789.85	800.40	10.55
9	1219.70	1231.90	12.20
10	760.25	770.60	10.35
11	1198.00	1207.80	9.80



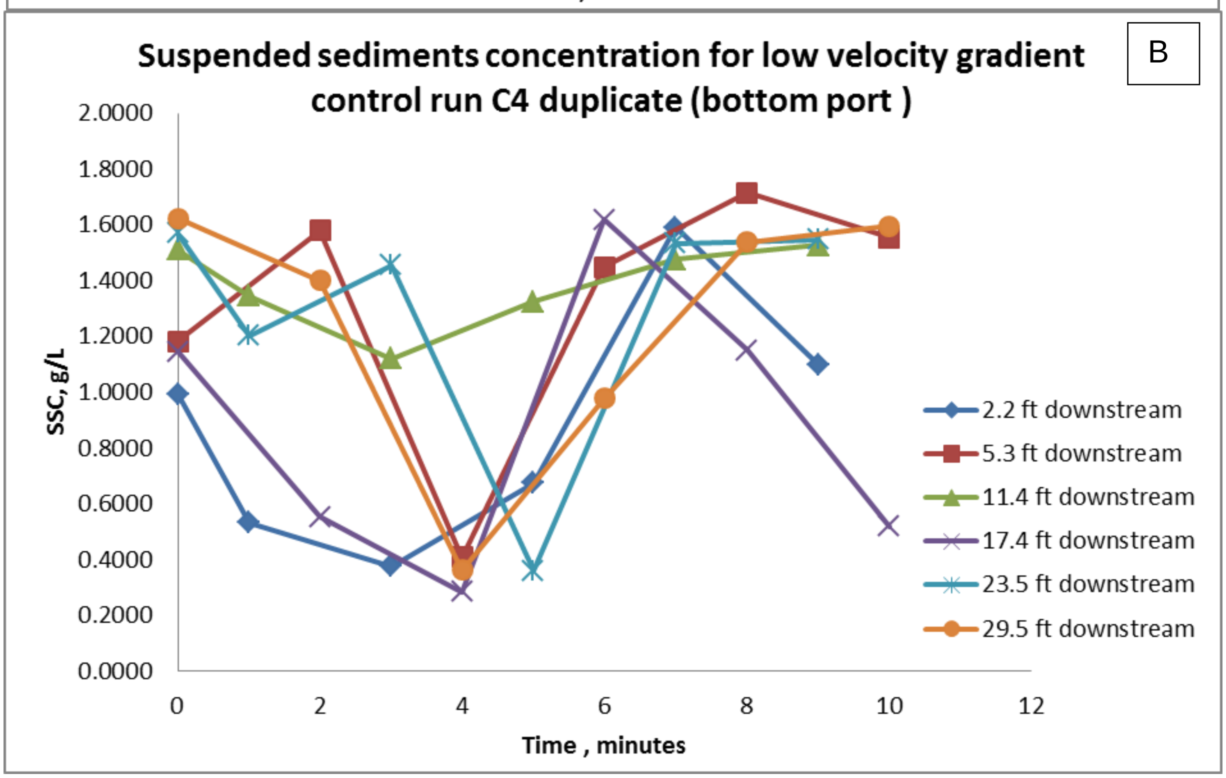


Figure 18. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

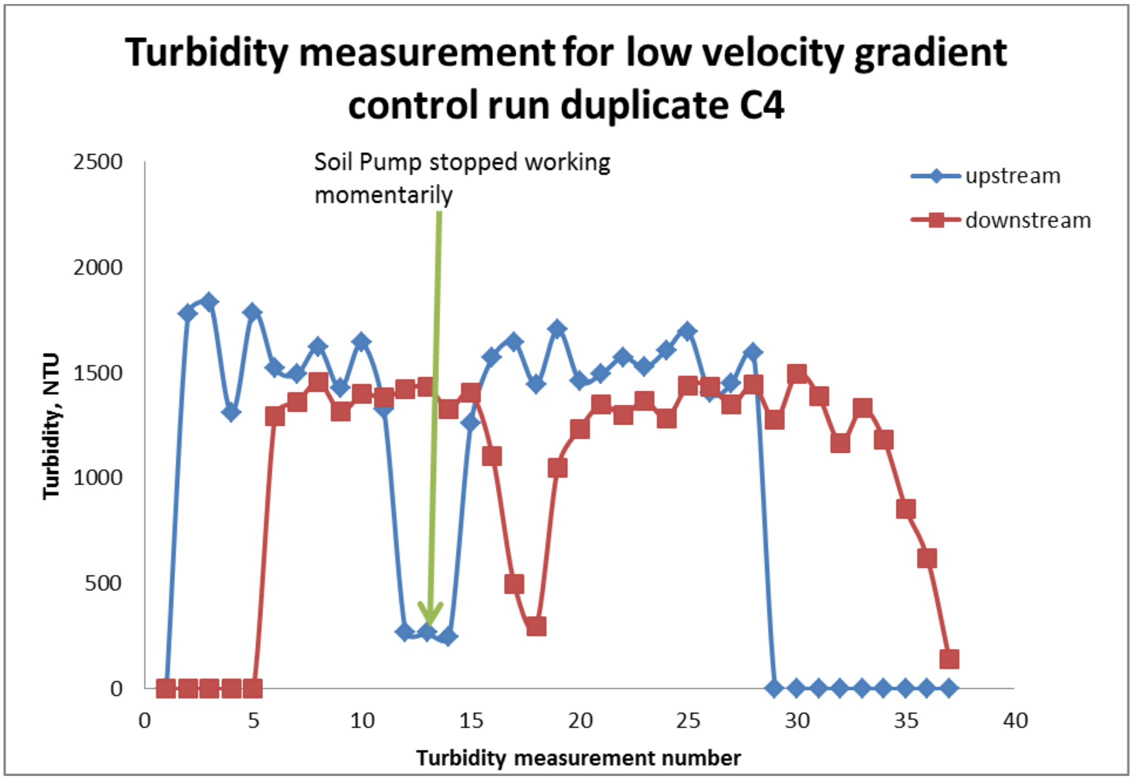


Figure 19. Upstream and downstream turbidity for low velocity gradient control run duplicate C4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Port A High Velocity Gradient Control Run Duplicate (C5)</u>

The speed of the oscillating grids was set at 148 rpm. Tables 36 to 42 show the concentration of the sediment measured at all the sampling stations, and Table 43 shows the mass of the sediment that settled in the trays during flocculation. Figure 20 shows the graph of the suspended sediment concentration at all the sampling stations, and Figure 21 shows the graph of the upstream and downstream turbidity measured for the run

Table 36. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 1.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	26.3436	26.4455	26.7651	26.8992	0.4215	0.4537	1.6860	1.8148
2	26.3545	26.3905	26.8047	26.8434	0.4502	0.4529	1.8008	1.8116
3	26.4325	26.3110	26.7736	26.7521	0.3411	0.4411	1.3644	1.7644
4	26.3778	26.4266	26.8125	26.7524	0.4347	0.3258	1.7388	1.3032
5	26.4560	26.4682	26.8985	26.9082	0.4425	0.4400	1.7700	1.7600
6	26.4443	26.3838	26.8884	26.8195	0.4441	0.4357	1.7764	1.7428

Table 37. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 2.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2		B	T	B	T	B	T	B
1	26.4112	26.4328	26.8274	26.8640	0.4162	0.4312	1.6648	1.7248
2	26.5653	26.3078	26.9000	26.7300	0.3347	0.4222	1.3388	1.6888
3	26.4007	26.4334	26.7982	26.8440	0.3975	0.4106	1.5900	1.6424
4	26.4359	26.5197	26.7256	26.9122	0.2897	0.3925	1.1588	1.5700
5	26.4546	26.5908	26.8857	26.9133	0.4311	0.3225	1.7244	1.2900
6	26.5382	26.4856	26.9803	26.9080	0.4421	0.4224	1.7684	1.6896

Table 38. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 3.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4407	26.5383	26.9063	26.8800	0.4656	0.3417	1.8624	1.3668
2	26.3478	26.3172	26.7986	26.7704	0.4508	0.4532	1.8032	1.8128
3	26.3376	26.3825	26.7915	26.8331	0.4539	0.4506	1.8156	1.8024
4	26.4329	26.4861	26.7276	26.8975	0.2947	0.4114	1.1788	1.6456
5	26.3163	26.2971	26.7739	26.7661	0.4576	0.469	1.8304	1.8760
6	26.4176	26.5558	26.8888	26.9239	0.4712	0.3681	1.8848	1.4724

Table 39. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 4.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3312	26.4726	26.7340	26.8526	0.4028	0.3800	1.6112	1.5200
2	26.4814	26.5641	26.9216	26.7917	0.4402	0.2276	1.7608	0.9104
3	26.4255	26.3583	26.8788	26.7460	0.4533	0.3877	1.8132	1.5508
4	26.3937	26.3543	26.8475	26.7887	0.4538	0.4344	1.8152	1.7376
5	26.4525	26.3012	26.9106	26.7650	0.4581	0.4638	1.8324	1.8552
6	26.3632	26.3852	26.8282	26.8618	0.4650	0.4766	1.8600	1.9064

Table 40. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 5.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.4566	26.4006	26.8477	26.7462	0.3911	0.3456	1.5644	1.3824
2	26.2901	26.5147	26.7194	26.9560	0.4293	0.4413	1.7172	1.7652
3	26.3576	26.7004	26.7829	26.7757	0.4253	0.0753	1.7012	0.3012
4	26.4606	26.4082	26.8723	26.8521	0.4117	0.4439	1.6468	1.7756
5	26.2960	26.2839	26.7309	26.7318	0.4349	0.4479	1.7396	1.7916
6	26.4069	26.4598	26.8384	26.7503	0.4315	0.2905	1.7260	1.1620

Table 41. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.4889	26.3530	26.8647	26.7418	0.3758	0.3888	1.5032	1.5552
2	26.3612	26.5234	26.7783	26.7867	0.4171	0.2633	1.6684	1.0532
3	26.4446	26.3487	26.8615	26.7807	0.4169	0.4320	1.6676	1.7280
4	26.3112	26.5444	26.7027	26.9544	0.3915	0.4100	1.5660	1.6400
5	26.3755	26.4042	26.7897	26.8589	0.4142	0.4547	1.6568	1.8188
6	26.3000	26.4195	26.7206	26.8632	0.4206	0.4437	1.6824	1.7748

Table 42. Suspended sediment concentration for high velocity gradient control run duplicate C5 at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3286	26.7220	0.3934	1.5736
2	26.3236	26.7265	0.4029	1.6116
3	26.3772	26.8073	0.4301	1.7204
4	26.3320	26.7738	0.4418	1.7672
5	26.4765	26.8595	0.3830	1.5320
6	26.3354	26.7682	0.4328	1.7312

Table 43. Mass of the sediment settled in the trays for high velocity gradient control run duplicate C5

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	435.20	437.95	2.75
2	785.55	794.00	8.45
3	825.30	833.45	8.15
4	786.90	797.60	10.70
5	786.05	796.60	10.55
6	789.35	800.85	11.50
7	393.20	403.70	10.50
8	789.15	800.40	11.25
9	828.80	837.50	8.70
10	1224.25	1235.55	11.30
11	760.05	770.65	10.60

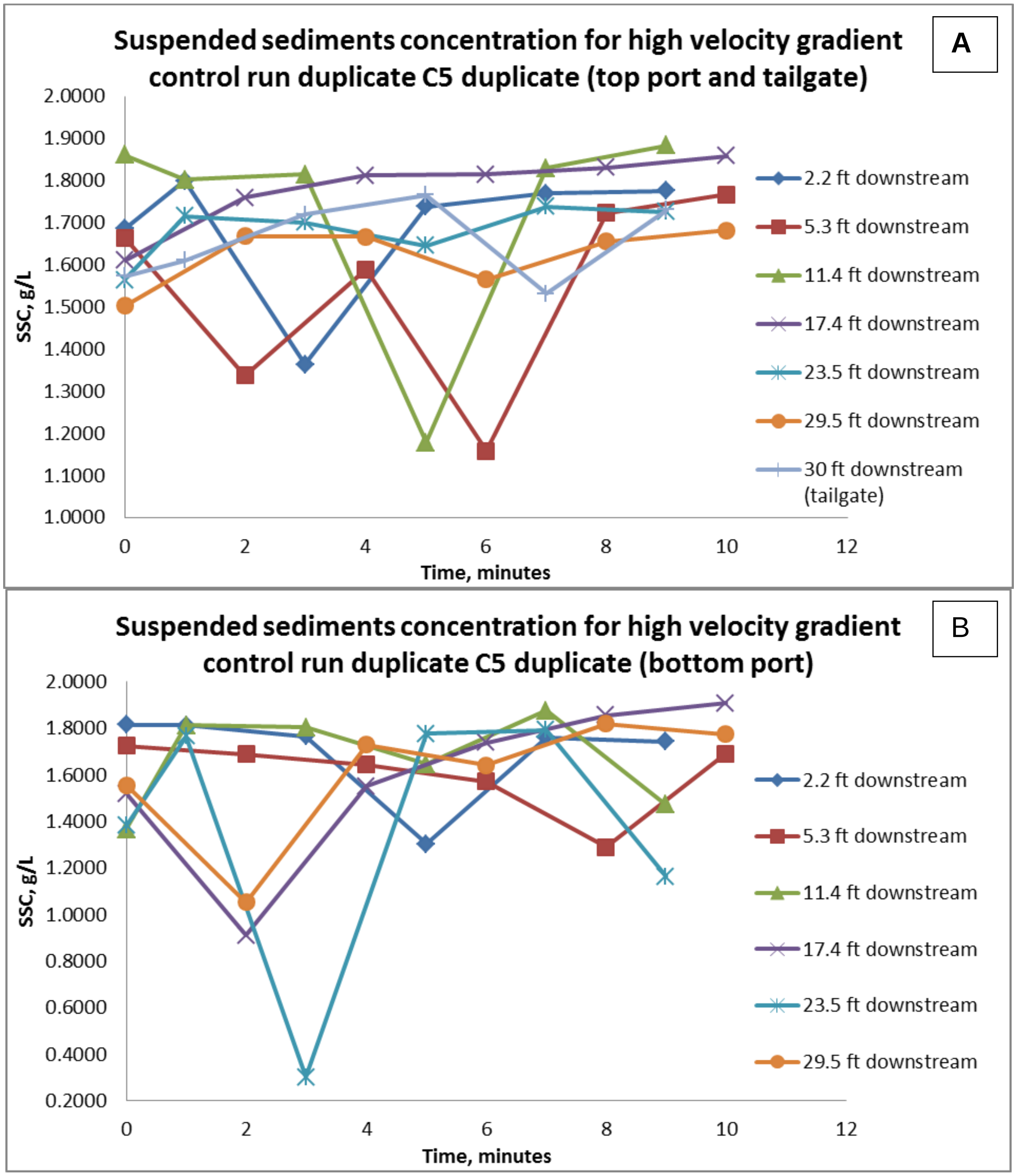


Figure 20. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

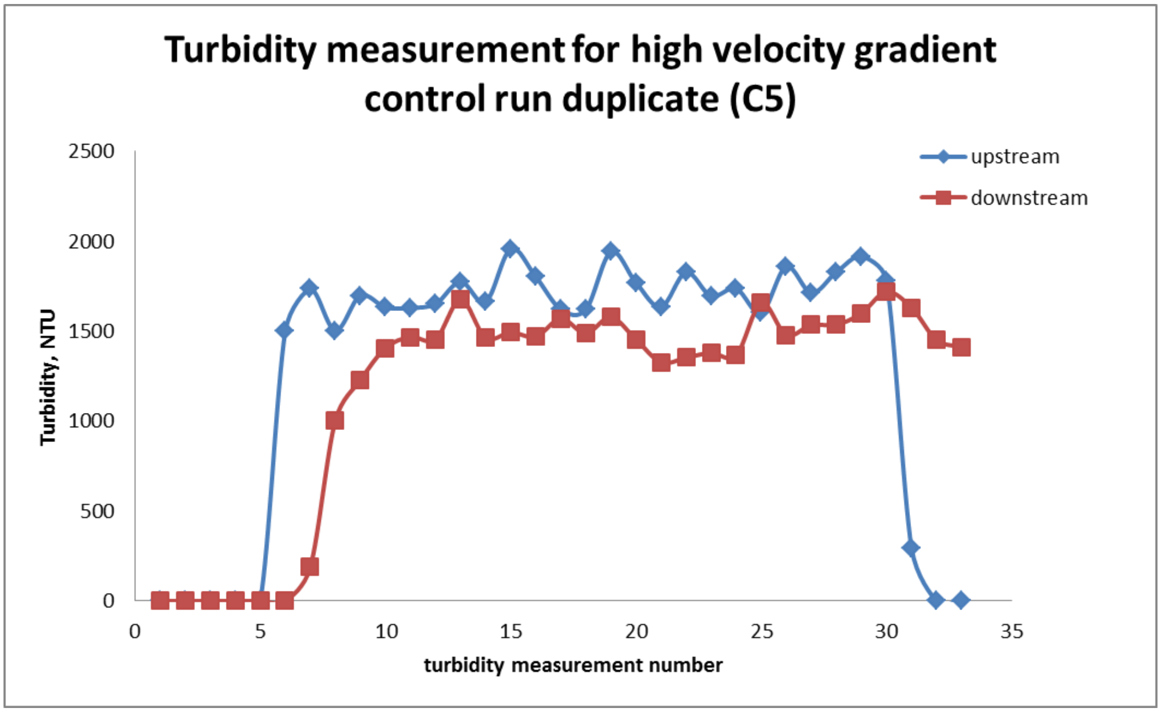


Figure 21. Upstream and downstream turbidity for high velocity gradient control run duplicate C5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Port A Control Run without Agitation Duplicate (C6)</u>

Tables 44 to 50 show the concentration of the suspended sediment measured in the top and bottom ports at the six stations and the tailgate. Table 51 shows the mass of the sediments that settled in the trays at the bottom of the flume. Figure 22 shows the graph of the suspended sediment concentration in the top and bottom ports, and Figure 23 shows the graph of the upstream and downstream turbidity.

Table 44. Suspended sediment concentration for control run without agitation duplicate C6.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.6850	31.6930	31.8348	31.8916	0.1498	0.1986	0.5992	0.7944
2	26.7935	31.5061	26.7916	31.6020	-	0.0959	-	0.3836
3	31.5682	26.5469	31.8362	26.8069	0.2680	0.2600	1.0720	1.0400
4	31.6960	26.5760	31.8087	26.7632	0.1127	0.1872	0.4508	0.7488
5	26.5641	26.4603	26.8264	26.8264	0.2623	0.3661	1.0492	1.4644
6	31.7930	26.7844	31.9842	27.0506	0.1912	0.2662	0.7648	1.0648

Table 45. Suspended sediment concentration for control run without agitation duplicate C6.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.7560	26.5135	31.8512	26.8358	0.0952	0.3223	0.3808	1.2892
2	26.8654	26.5431	26.9179	26.7963	0.0525	0.2532	0.2100	1.0128
3	26.4616	31.7131	26.7733	31.9836	0.3117	0.2705	1.2468	1.0820
4	26.5421	31.6561	26.7502	31.8212	0.2081	0.1651	0.8324	0.6604
5	31.6432	26.4543	31.6762	26.6040	0.0330	0.1497	0.1320	0.5988
6	31.7845	26.4000	31.9517	26.8400	0.1672	0.4400	0.6688	1.7600

Table 46. Suspended sediment concentration for control run without agitation duplicate C6.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5700	26.4595	26.8713	26.6980	0.3013	0.2385	1.2052	0.9540
2	26.4852	26.5608	26.8446	26.7226	0.3594	0.1618	1.4376	0.6472
3	31.3081	31.5596	31.5970	31.7521	0.2889	0.1925	1.1556	0.7700
4	26.7745	31.4980	26.9502	31.6567	0.1757	0.1587	0.7028	0.6348
5	26.7746	26.5970	26.9949	26.8969	0.2203	0.2999	0.8812	1.1996
6	31.7568	26.5446	31.8797	27.0373	0.1229	0.4927	0.4916	1.9708

Table 47. Suspended sediment concentration for control run without agitation duplicate C6.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.6426	31.7261	31.8484	31.9479	0.2058	0.2218	0.8232	0.8872
2	26.5926	26.5890	26.8999	26.9866	0.3073	0.3976	1.2292	1.5904
3	31.6795	26.4221	31.8649	26.8607	0.1854	0.4386	0.7416	1.7544
4	26.2847	31.4074	26.7172	31.6357	0.4325	0.2283	1.7300	0.9132
5	31.6190	31.3980	31.8714	31.5970	0.2524	0.1990	1.0096	0.7960
6	31.5707	31.6244	31.8588	32.0087	0.2881	0.3843	1.1524	1.5372

Table 48. Suspended sediment concentration for control run without agitation duplicate C6.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.7885	26.6717	26.8187	26.9351	0.0302	0.2634	0.1208	1.0536
2	26.5094	31.7320	26.7728	31.8918	0.2634	0.1598	1.0536	0.6392
3	26.7413	26.4873	26.9608	26.7129	0.2195	0.2256	0.8780	0.9024
4	31.5765	31.7341	31.8323	31.8327	0.2558	0.0986	1.0232	0.3944
5	26.5796	26.5536	26.9660	26.7472	0.3864	0.1936	1.5456	0.7744
6	26.4730	26.4920	26.7977	26.6135	0.3247	0.1215	1.2988	0.4860

Table 49. Suspended sediment concentration for control run without agitation duplicate C6.at Station 6

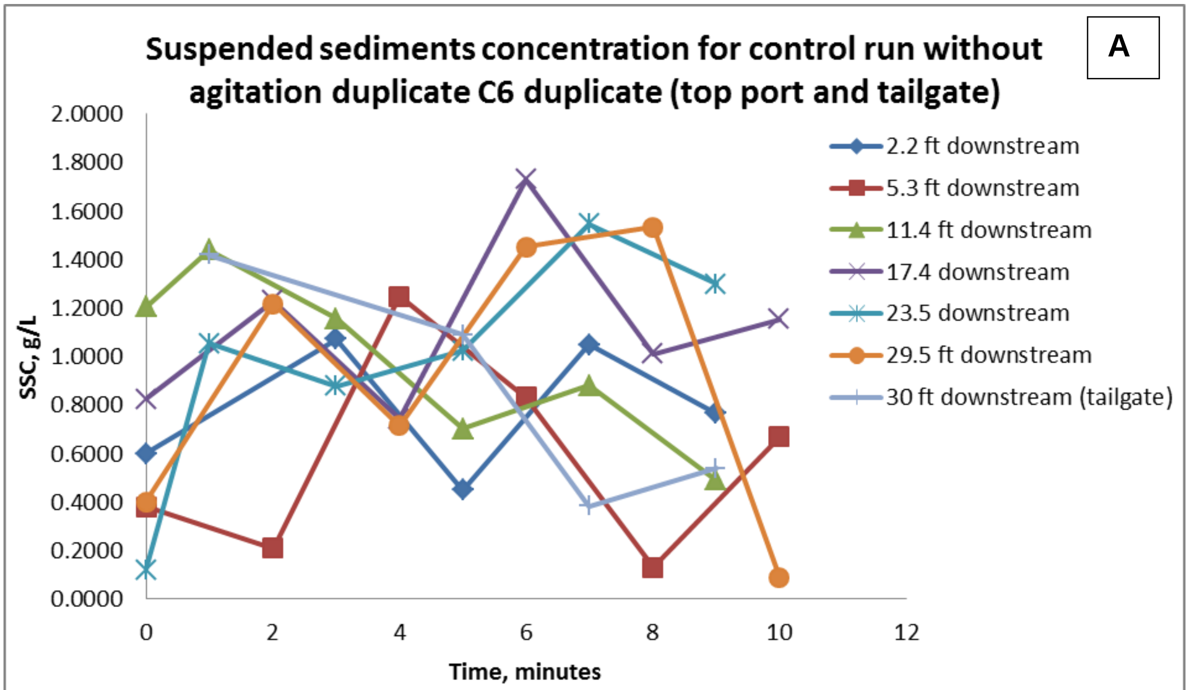
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5654	31.5325	26.6660	31.7444	0.1006	0.2119	0.4024	0.8476
2	26.4091	31.8841	26.7136	31.9014	0.3045	0.0173	1.2180	0.0692
3	26.7871	31.5455	26.9661	31.8331	0.1790	0.2876	0.7160	1.1504
4	26.4930	26.7094	26.8558	26.9335	0.3628	0.2241	1.4512	0.8964
5	26.5213	26.3325	26.9043	26.7723	0.3830	0.4398	1.5320	1.7592
6	31.5321	31.6617	31.5548	31.6711	0.0227	0.0094	0.0908	0.0376

Table 50. Suspended sediment concentration for control run without agitation duplicate C6.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.6370	26.5673	-	-
2	26.4327	26.7872	0.3545	1.4180
3	26.8153	26.7808	-	-
4	31.5518	31.8240	0.2722	1.0888
5	31.7882	31.8843	0.0961	0.3844
6	31.6752	31.8096	0.1344	0.5376

Table 51. Mass of the sediment settled in the trays for control run without agitation duplicate C6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	73.55	76.55	3.00
2	73.40	82.35	8.95
3	74.40	85.20	10.80
4	75.10	85.90	10.80
5	69.82	81.20	11.38
6	74.50	86.70	12.20
7	72.20	84.75	12.55
8	73.55	86.05	12.50
9	74.30	85.60	11.30
10	74.55	86.90	12.35
11	73.70	85.45	11.75



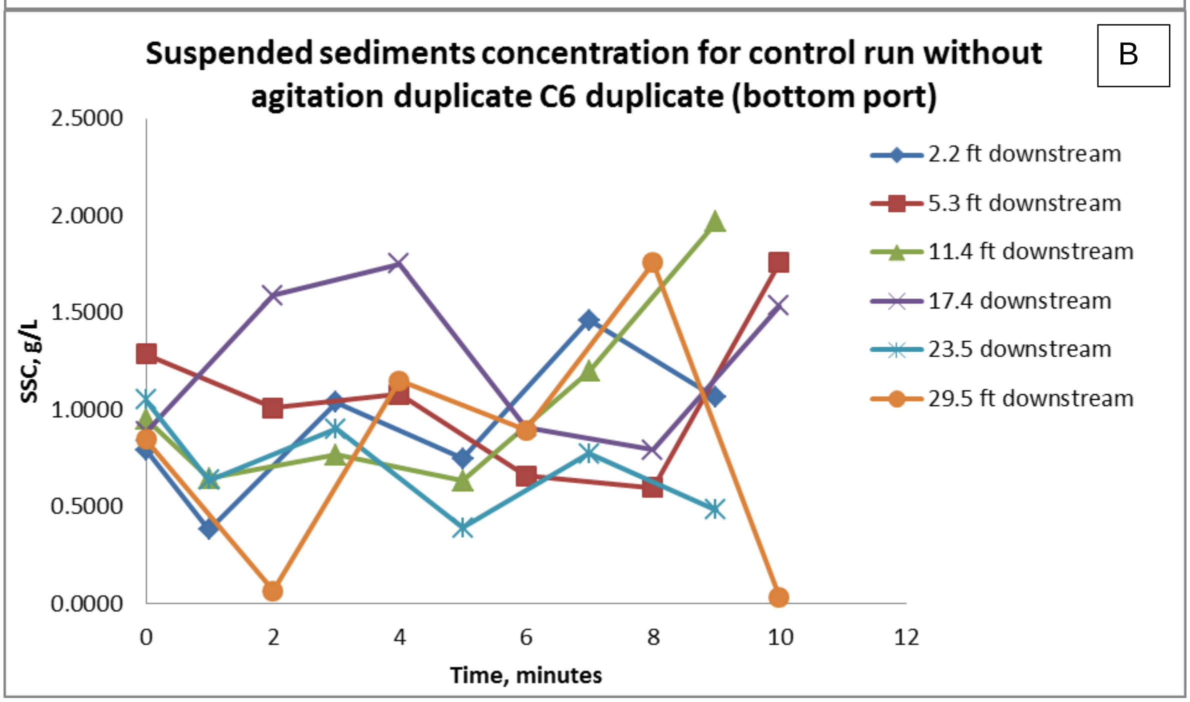


Figure 22. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

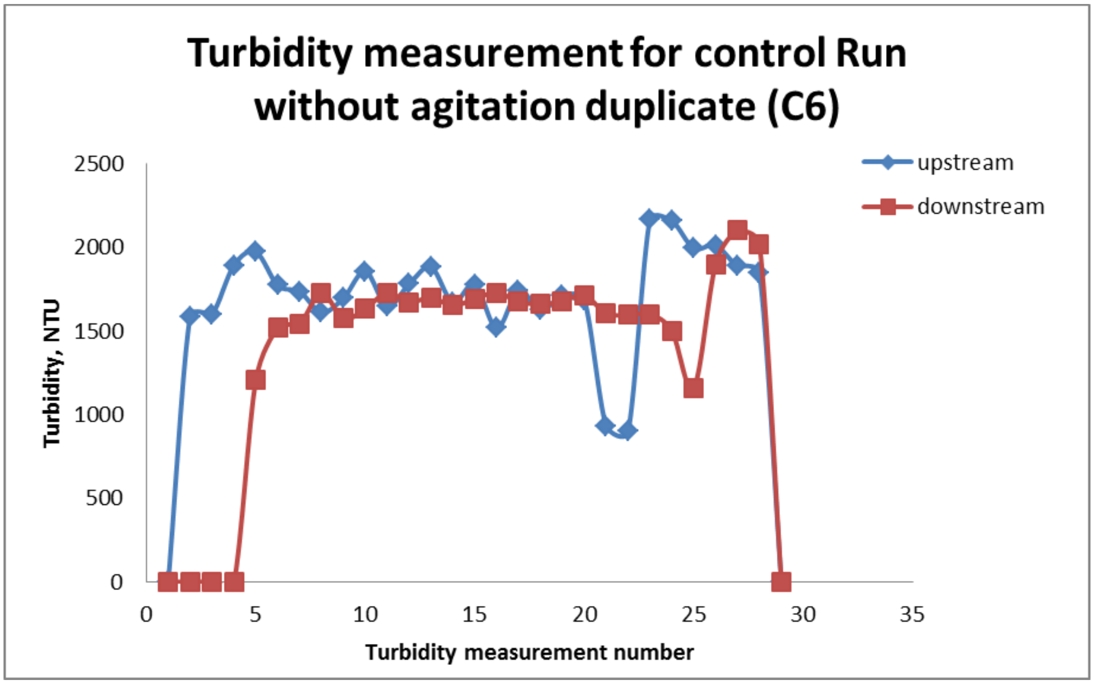


Figure 23. Upstream and downstream turbidity for control run without agitation duplicate C6. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

Port A Low Velocity Gradient Flocculation Run (F1):

The speed of the oscillating grids was set to 99 rpm. Tables 52 to 58 show the data for the concentration of the suspended sediments, and Table 59 shows these data for sediment mass that settled in the trays at the end of the run. Figure 24 shows the graph of the suspended sediment concentration, and Figure 25 shows the graph of the upstream and downstream turbidity.

Table 52. Suspended sediment concentration for low velocity gradient flocculation run F1.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5431	31.3863	31.9318	31.7906	0.3887	0.4043	1.5548	1.6172
2	31.5225	31.2649	31.9133	31.6635	0.3908	0.3986	1.5632	1.5944
3	31.3860	31.4631	31.7740	31.8785	0.3880	0.4154	1.5520	1.6616
4	31.2327	31.4153	31.5910	31.8139	0.3583	0.3986	1.4332	1.5944
5	31.2294	31.3931	31.6233	31.8003	0.3939	0.4072	1.5756	1.6288
6	31.3312	31.3729	31.7249	31.7689	0.3937	0.3960	1.5748	1.5840

Table 53. Suspended sediment concentration for low velocity gradient flocculation run F1.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1511	31.3625	31.5344	31.7521	0.3833	0.3896	1.5332	1.5584
2	31.4797	31.4353	31.8680	31.8296	0.3883	0.3943	1.5532	1.5772
3	31.4592	31.2281	31.8455	31.6189	0.3863	0.3908	1.5452	1.5632
4	31.4929	31.3258	31.8798	31.7181	0.3869	0.3923	1.5476	1.5692
5	31.3638	31.3894	31.7579	31.7836	0.3941	0.3942	1.5764	1.5768
6	31.4610	31.1386	31.8405	31.5555	0.3795	0.4169	1.5180	1.6676

Table 54. Suspended sediment concentration for low velocity gradient flocculation run F1.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3593	31.4890	31.7521	31.8874	0.3928	0.3984	1.5712	1.5936
2	31.4008	31.4274	31.9098	31.8882	0.5090	0.4608	2.0360	1.8432
3	31.4814	31.5444	31.8711	31.9132	0.3897	0.3688	1.5588	1.4752
4	31.4738	31.4605	31.8530	31.8324	0.3792	0.3719	1.5168	1.4876
5	31.4088	31.3263	31.7910	31.7005	0.3822	0.3742	1.5288	1.4968
6	31.3323	31.4466	31.7136	31.8235	0.3813	0.3769	1.5252	1.5076

Table 55. Suspended sediment concentration for low velocity gradient flocculation run F1.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4091	31.4737	31.7964	31.8535	0.3873	0.3798	1.5492	1.5192
2	31.2257	31.4835	31.4381	31.8560	0.2124	0.3725	0.8496	1.4900
3	31.1994	31.4773	31.4040	31.8511	0.2046	0.3738	0.8184	1.4952
4	31.4854	31.4319	31.6925	31.7980	0.2071	0.3661	0.8284	1.4644
5	31.4313	31.5339	31.6489	31.9160	0.2176	0.3821	0.8704	1.5284
6	31.3916	31.2084	31.6079	31.6181	0.2163	0.4097	0.8652	1.6388

Table 56. Suspended sediment concentration for low velocity gradient flocculation run F1.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3775	31.4599	31.7348	31.8057	0.3573	0.3458	1.4292	5.7168
2	31.3846	31.4516	31.5733	31.7591	0.1887	0.3075	0.7548	3.0192
3	31.4590	31.4365	31.6178	31.6385	0.1588	0.2020	0.6352	2.5408
4	31.4030	31.4460	31.5544	31.6428	0.1514	0.1968	0.6056	2.4224
5	31.4760	31.4153	31.6291	31.6122	0.1531	0.1969	0.6124	2.4496
6	31.4352	31.3703	31.5956	31.5845	0.1604	0.2142	0.6416	2.5664

Table 57. Suspended sediment concentration for low velocity gradient flocculation run F1.at Station 6

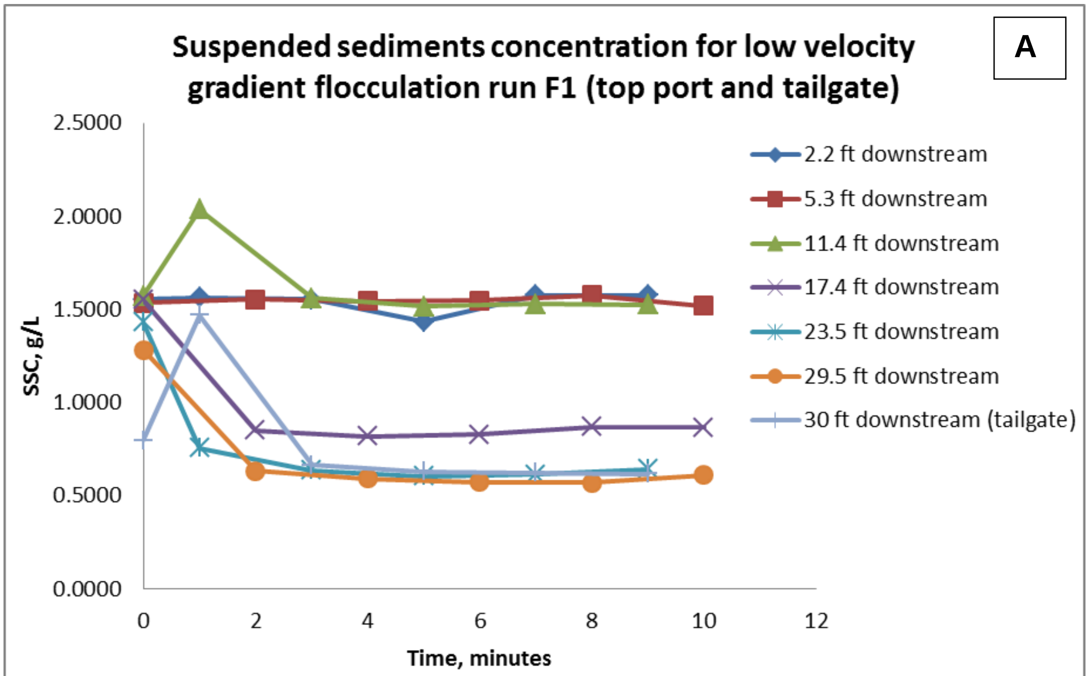
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4633	31.1974	31.7836	31.5477	0.3203	0.3503	1.2812	1.4012
2	31.2113	31.3573	31.3692	31.5741	0.1579	0.2168	0.6316	0.8672
3	31.4555	31.3711	31.6031	31.5462	0.1476	0.1751	0.5904	0.7004
4	31.3527	31.3640	31.4958	31.5415	0.1431	0.1775	0.5724	0.7100
5	31.4251	31.4185	31.5676	31.5848	0.1425	0.1663	0.5700	0.6652
6	31.1427	31.4108	31.2957	31.5957	0.1530	0.1849	0.6120	0.7396

Table 58. Suspended sediment concentration for low velocity gradient flocculation run F1.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	31.4471	31.6466	0.1995	0.7980
2	31.3844	31.7518	0.3674	1.4696
3	31.4047	31.5704	0.1657	0.6628
4	31.1404	31.2980	0.1576	0.6304
5	31.3771	31.5329	0.1558	0.6232
6	31.3839	31.5379	0.1540	0.6160

Table 59. Mass of the sediment settled in the trays for low velocity gradient flocculation run F1.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.25	762.95	2.70
2	760.00	789.35	29.35
3	760.70	799.15	38.45
4	1520.90	1582.70	61.80
5	1520.70	1693.70	173.00
6	1520.75	1960.00	439.25
7	2280.05	2890.40	610.35
8	1520.95	1840.90	319.95
9	1520.15	1659.30	139.15
10	1520.80	1598.90	78.10
11	1521.10	1570.90	49.80



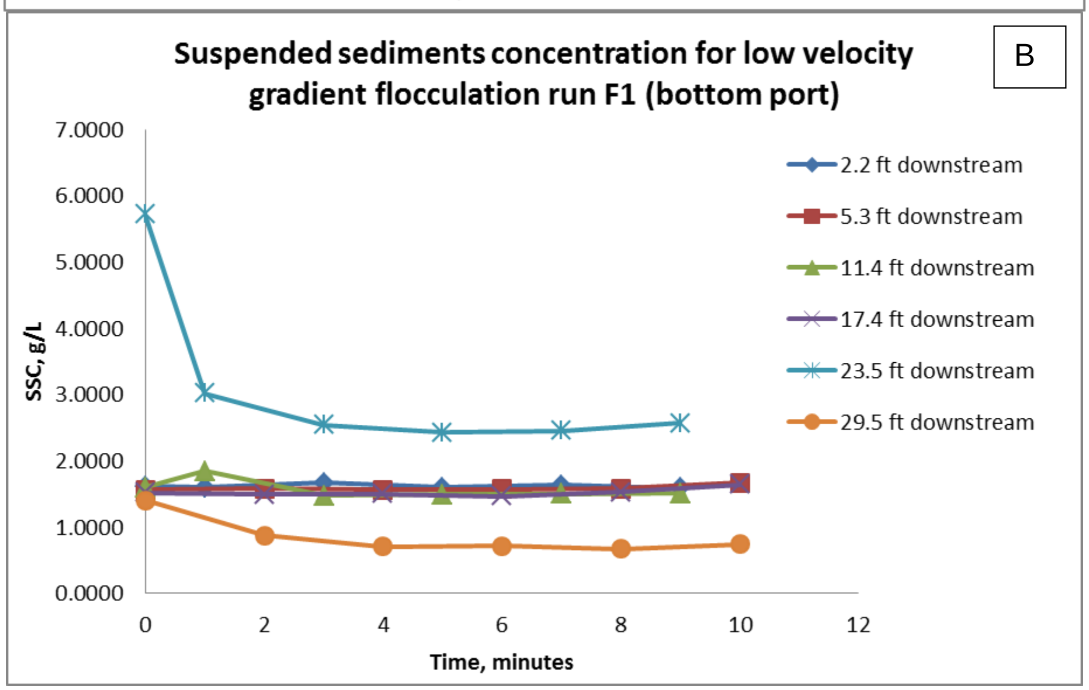


Figure 24. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

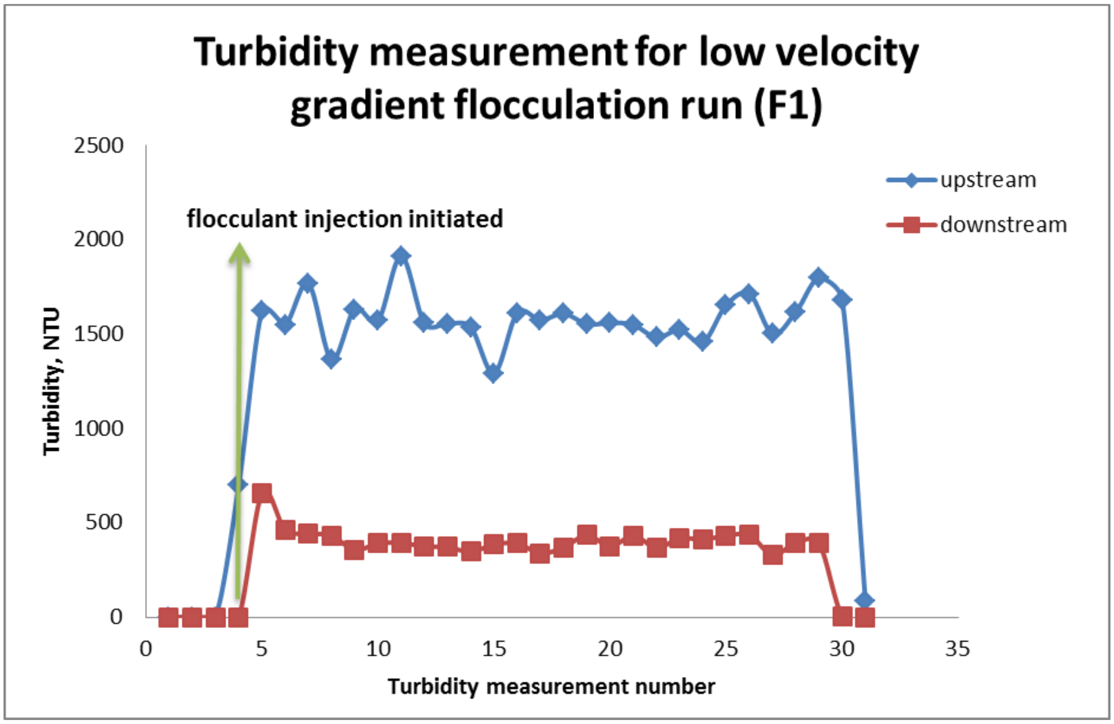


Figure 25. Upstream and downstream turbidity for low velocity gradient flocculation run F1. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Port A High Velocity Gradient Flocculation Run (F2):</u>

The speed of the oscillating grids was set to 148 rpm. Tables 60 to 66 shows the data for the concentration of the suspended sediments, and Table 67 shows the data for the sediment masses that settled in the trays at the end of the run. Figure 26 shows the graph of the suspended sediment concentration, and Figure 27 shows the graph of the upstream and downstream turbidity.

Table 60. Suspended sediment concentration for high velocity gradient flocculation run F2. at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3088	26.4333	26.5682	26.7669	0.2594	0.3336	1.0376	1.3344
2	26.3396	26.3846	26.7650	26.8044	0.4254	0.4198	1.7016	1.6792
3	26.3120	26.2969	26.7535	26.7164	0.4415	0.4195	1.7660	1.6780
4	26.3567	26.2994	26.7684	26.7226	0.4117	0.4232	1.6468	1.6928
5	26.4515	26.4603	26.8924	26.8936	0.4409	0.4333	1.7636	1.7332
6	26.4672	26.3729	26.8747	26.7842	0.4075	0.4113	1.6300	1.6452

Table 61. Suspended sediment concentration for high velocity gradient flocculation run F2. at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4283	26.3516	26.7048	26.8288	0.2765	0.4772	1.1060	1.9088
2	26.2957	26.4716	26.8655	26.7018	0.5698	0.2302	2.2792	0.9208
3	26.3845	26.5389	26.7751	26.9440	0.3906	0.4051	1.5624	1.6204
4	26.2796	26.4380	26.6729	26.8514	0.3933	0.4134	1.5732	1.6536
5	26.4488	26.4629	26.8554	26.8655	0.4066	0.4026	1.6264	1.6104
6	26.5346	26.4480	26.9294	26.8398	0.3948	0.3918	1.5792	1.5672

Table 62. Suspended sediment concentration for high velocity gradient flocculation run F2. at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station3	T	B	T	B	T	B	T	B
1	26.4407	26.2781	26.8624	26.6891	0.4217	0.4110	1.6868	1.6440
2	26.3371	26.3072	26.6914	26.6942	0.3543	0.3870	1.4172	1.5480
3	26.3318	26.4368	26.7551	26.7962	0.4233	0.3594	1.6932	1.4376
4	26.3696	26.4509	26.7564	26.8487	0.3868	0.3978	1.5472	1.5912
5	26.2985	26.2960	26.6988	26.7115	0.4003	0.4155	1.6012	1.6620
6	26.4162	26.4572	26.8148	26.8716	0.3986	0.4144	1.5944	1.6576

Table 63. Suspended sediment concentration for high velocity gradient flocculation run F2. at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.3210	26.4642	26.7386	26.8762	0.4176	0.4120	1.6704	1.6480
2	26.4750	26.3346	26.8096	26.7218	0.3346	0.3872	1.3384	1.5488
3	26.4215	26.2682	26.7591	26.6406	0.3376	0.3724	1.3504	1.4896
4	26.3816	26.3250	26.7142	26.7016	0.3326	0.3766	1.3304	1.5064
5	26.4397	26.3124	26.7768	26.7196	0.3371	0.4072	1.3484	1.6288
6	26.3532	26.3994	26.6855	26.7814	0.3323	0.3820	1.3292	1.5280

Table 64. Suspended sediment concentration for high velocity gradient flocculation run F2. at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4189	26.3147	26.8168	26.7153	0.3979	0.4006	1.5916	6.3664
2	26.3663	26.4917	26.5014	26.6542	0.1351	0.1625	0.5404	2.1616
3	26.3439	26.3198	26.5459	26.6198	0.2020	0.3000	0.8080	3.2320
4	26.4503	26.2700	26.6555	26.5723	0.2052	0.3023	0.8208	3.2832
5	26.2817	26.3825	26.4883	26.6818	0.2066	0.2993	0.8264	3.3056
6	26.4000	26.2957	26.6123	26.5951	0.2123	0.2994	0.8492	3.3968

Table 65. Suspended sediment concentration for high velocity gradient flocculation run F2. at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4743	26.3377	26.8531	26.7188	0.3788	0.3811	1.5152	1.5244
2	26.3444	26.3405	26.5254	26.5753	0.1810	0.2348	0.7240	0.9392
3	26.4246	26.3328	26.6051	26.5605	0.1805	0.2277	0.7220	0.9108
4	26.3062	26.5270	26.4841	26.7524	0.1779	0.2254	0.7116	0.9016
5	26.3271	26.3912	26.5059	26.6200	0.1788	0.2288	0.7152	0.9152
6	26.2900	26.3956	26.4696	26.6253	0.1796	0.2297	0.7184	0.9188

Table 66. Suspended sediment concentration for high velocity gradient flocculation run F2. at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.3125	26.5726	0.2601	1.0404
2	26.3039	26.4542	0.1503	0.6012
3	26.3565	26.5348	0.1783	0.7132
4	26.3194	26.4980	0.1786	0.7144
5	26.4142	26.5868	0.1726	0.6904
6	26.3167	26.4903	0.1736	0.6944

Table 67. Mass of the sediment settled in the trays for high velocity gradient flocculation run F2.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.15	402.10	5.95
2	759.75	797.80	38.05
3	760.20	793.25	33.05
4	760.25	800.80	40.55
5	1519.30	1588.15	68.85
6	1520.05	1659.00	138.95
7	1518.55	1778.50	259.95
8	1519.55	1913.25	393.70
9	1521.00	1878.40	357.40
10	1519.75	1747.80	228.05
11	1522.10	1671.75	149.65

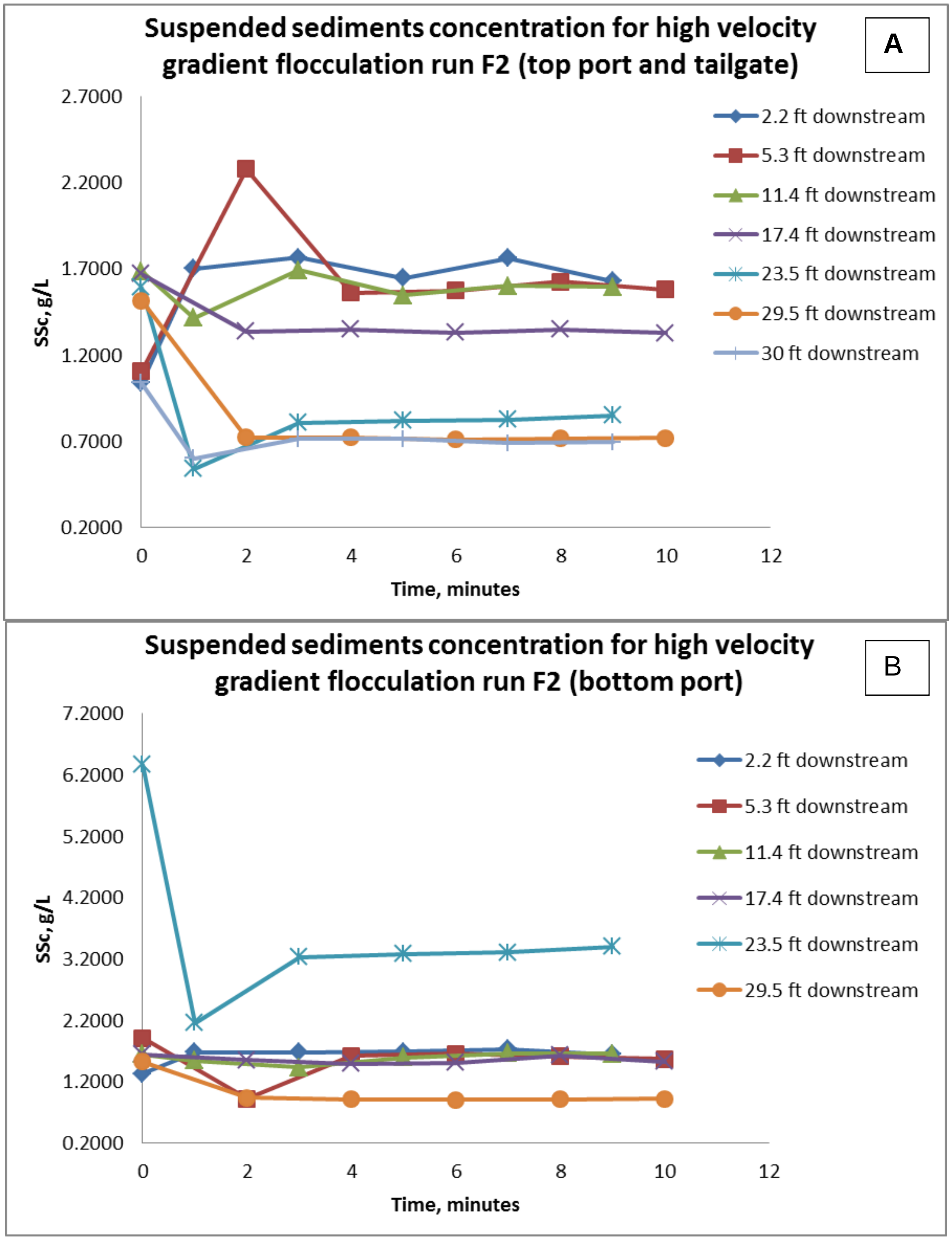


Figure 26. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

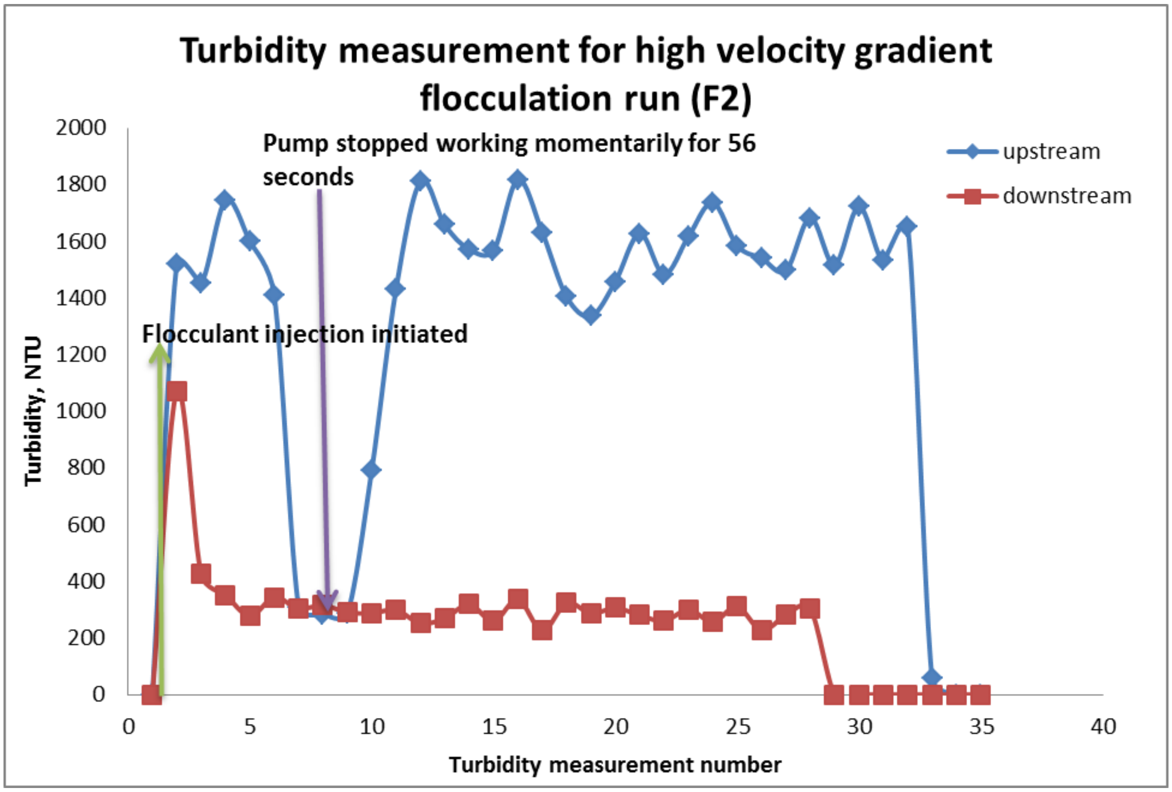


Figure 27. Upstream and downstream turbidity for high velocity gradient flocculation run F2. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port A Low Velocity Gradient Flocculation Run Duplicate (F3):</u>

The speed of the oscillating grids was set to 99 rpm. Tables 68 to 74 show the data for the concentration of the suspended sediments, and Table 75 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 28 shows the graph of the suspended sediment concentration, and Figure 29 shows the graph of the upstream and downstream turbidity.

Table 68. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3794	26.6340	26.7447	26.9492	0.3653	0.3152	1.4612	1.2608
2	26.2875	26.5693	26.7214	26.8641	0.4339	0.2948	1.7356	1.1792
3	26.4786	26.4321	26.7962	26.6703	0.3176	0.2382	1.2704	0.9528
4	26.3303	26.3601	26.6813	26.6725	0.3510	0.3124	1.4040	1.2496
5	26.4477	26.3957	26.8200	26.8137	0.3723	0.4180	1.4892	1.6720
6	26.5141	26.4754	26.9290	26.8960	0.4149	0.4206	1.6596	1.6824

Table 69. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5686	26.5674	26.8414	26.7051	0.2728	0.1377	1.0912	0.5508
2	26.6555	26.4619	26.9114	26.7523	0.2559	0.2904	1.0236	1.1616
3	26.2992	26.7624	26.7153	27.0328	0.4161	0.2704	1.6644	1.0816
4	26.3190	26.4932	26.7416	26.9256	0.4226	0.4324	1.6904	1.7296
5	26.4758	26.3093	26.8823	26.7252	0.4065	0.4159	1.6260	1.6636
6	26.4202	26.2972	26.8343	26.7085	0.4141	0.4113	1.6564	1.6452

Table 70. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5770	26.3079	26.8884	26.7140	0.3114	0.4061	1.2456	1.6244
2	26.3951	26.4744	26.6944	26.7522	0.2993	0.2778	1.1972	1.1112
3	26.6609	26.4113	26.9256	26.7135	0.2647	0.3022	1.0588	1.2088
4	26.5318	26.2890	26.8532	26.6638	0.3214	0.3748	1.2856	1.4992
5	26.3196	26.4827	26.7311	26.8724	0.4115	0.3897	1.6460	1.5588
6	26.2981	26.3608	26.6874	26.7553	0.3893	0.3945	1.5572	1.5780

Table 71. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4189	26.4998	26.7504	26.8350	0.3315	0.3352	1.3260	1.3408
2	26.5176	26.3783	26.5952	26.7659	0.0776	0.3876	0.3104	1.5504
3	26.4878	26.5493	26.6005	26.7303	0.1127	0.1810	0.4508	0.7240
4	26.4248	26.4263	26.5692	26.8048	0.1444	0.3785	0.5776	1.5140
5	26.5103	26.4030	26.6220	26.7120	0.1117	0.3090	0.4468	1.2360
6	26.4245	26.3603	26.6723	26.6957	0.2478	0.3354	0.9912	1.3416

Table 72. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4606	26.4856	26.7846	26.8119	0.3240	0.3263	1.2960	5.1840
2	26.5097	26.4219	26.5497	26.7496	0.0400	0.3277	0.1600	0.6400
3	26.5467	26.4206	26.5115	26.5953	-0.0352	0.1747	-	-
4	26.2695	26.5132	26.4238	26.5519	0.1543	0.0387	0.6172	2.4688
5	26.5194	26.5441	26.6394	26.6984	0.1200	0.1543	0.4800	1.9200
6	26.5673	26.5471	26.4404	26.7076	-0.1269	0.1605	-	-

Table 73. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.389	26.416	26.854	26.714	0.465	0.298	1.858	1.192
2	26.319	26.414	26.482	26.627	0.163	0.213	0.650	0.852
3	26.359	26.413	26.435	26.522	0.076	0.109	0.302	0.434
4	26.433	26.543	26.431	26.610	-0.003	0.067	-	0.268
5	26.452	26.426	26.564	26.472	0.112	0.046	0.447	0.186
6	26.342	26.765	26.488	26.623	0.146	-0.142	0.583	-

Table 74. Suspended sediment concentration for low velocity gradient flocculation duplicate run F3.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment concentration (g/L)
1	26.4611	26.771	0.3099	1.2396
2	26.407	26.7117	0.3047	1.2188
3	26.5914	26.4638	-	-
4	26.6712	26.6117	-	-
5	26.4485	26.5659	0.1174	0.4696
6	26.4822	26.4953	0.0131	0.0524

Table 75. Mass of the sediment settled in the trays for low velocity gradient flocculation run duplicate F3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.60	764.35	3.75
2	759.95	784.65	24.70
3	760.00	791.00	31.00
4	760.45	796.65	36.20
5	1520.85	1594.40	73.55
6	1518.75	1730.55	211.80
7	1520.45	1996.55	476.10
8	1520.15	2034.55	514.40
9	1520.05	1780.05	260.00
10	1519.35	1636.90	117.55
11	1520.50	1584.00	63.50

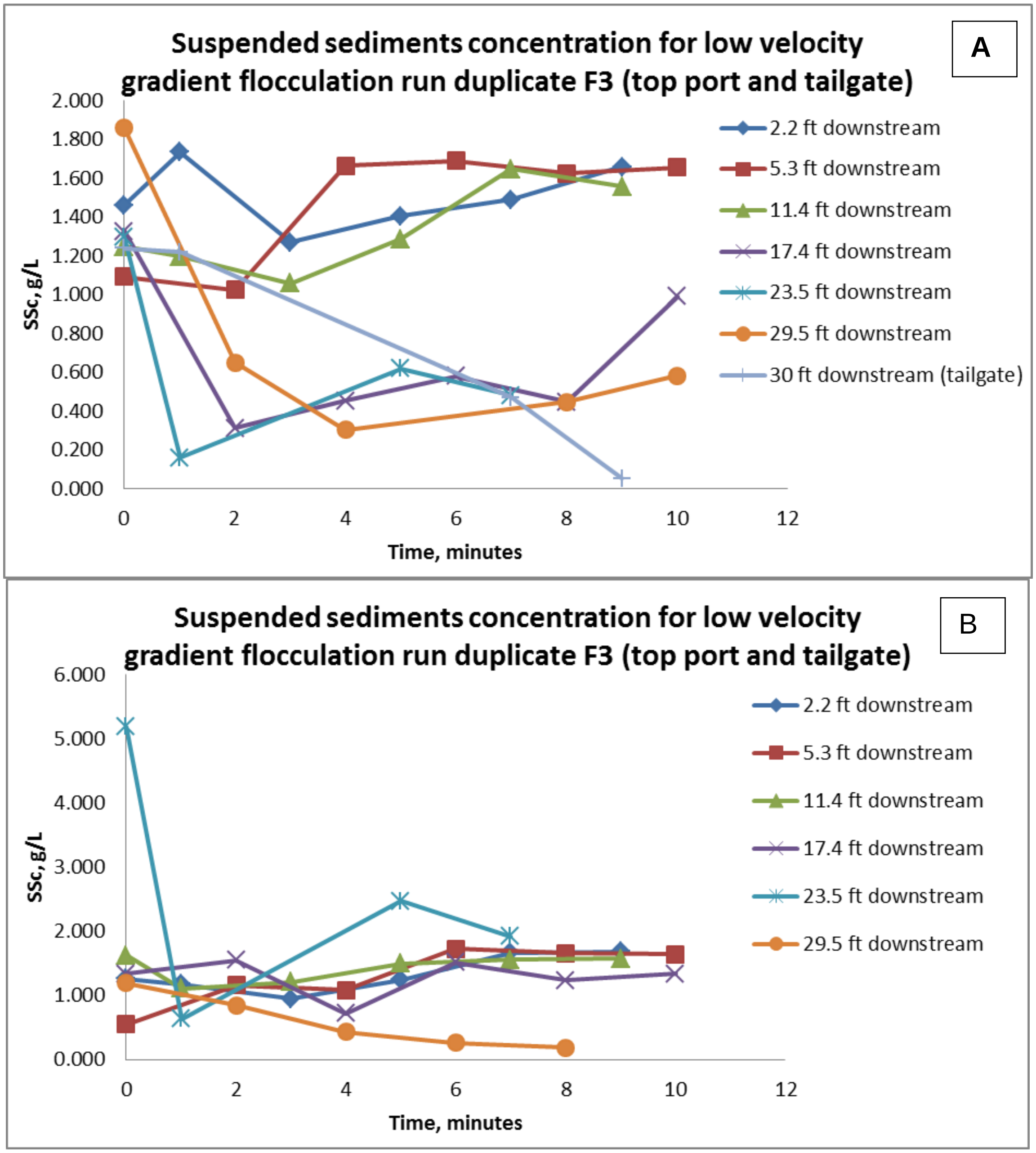


Figure 28. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

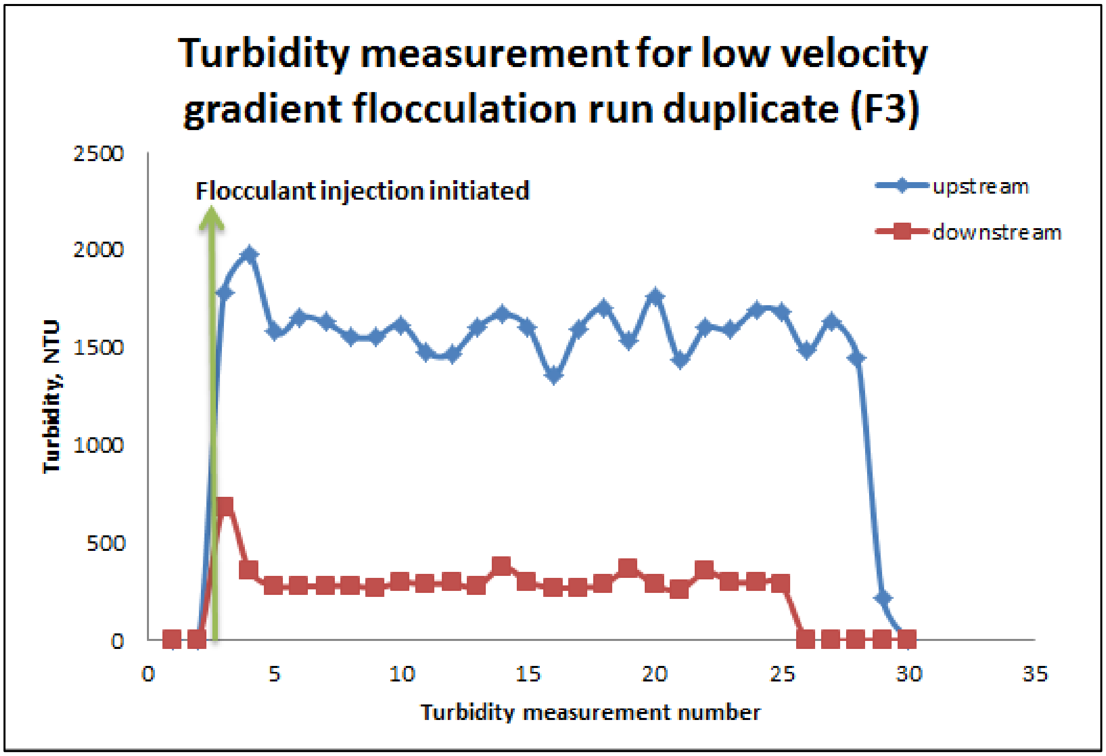


Figure 29. Upstream and downstream turbidity for low velocity gradient flocculation run duplicate F3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port A High Velocity Gradient Flocculation Run Duplicate (F4)</u>

The speed of the oscillating grids was set to 148 rpm. Table 76 to 82 show the data for the concentration of the suspended sediments, and Table 83 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 30 shows the graph of the suspended sediment concentration, and Figure 31 shows the graph of the upstream and downstream turbidity.

Table 76. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4. at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3300	31.3354	31.7256	31.7357	0.3956	0.4003	1.5824	1.6012
2	31.2056	31.3884	31.6161	31.8120	0.4105	0.4236	1.6420	1.6944
3	31.4671	31.1600	31.8829	31.5796	0.4158	0.4196	1.6632	1.6784
4	31.5404	31.4462	31.9542	31.8641	0.4138	0.4179	1.6552	1.6716
5	26.2624	31.4948	26.6722	31.8876	0.4098	0.3928	1.6392	1.5712
6	26.3270	26.3390	26.7319	26.7516	0.4049	0.4126	1.6196	1.6504

Table 77. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4226	26.4161	26.8397	26.8383	0.4171	0.4222	1.6684	1.6888
2	26.5593	26.2755	26.9711	26.6948	0.4118	0.4193	1.6472	1.6772
3	26.5021	26.4405	26.9075	26.8479	0.4054	0.4074	1.6216	1.6296
4	26.3066	26.4342	26.7073	26.8474	0.4007	0.4132	1.6028	1.6528
5	26.5301	26.5094	26.9221	26.9067	0.3920	0.3973	1.5680	1.5892
6	31.4224	26.2621	31.8101	26.6555	0.3877	0.3934	1.5508	1.5736

Table 78. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3442	26.5092	26.7561	26.9348	0.4119	0.4256	1.6476	1.7024
2	26.3071	26.3247	26.7117	26.7208	0.4046	0.3961	1.6184	1.5844
3	26.3067	26.5474	26.7124	26.9611	0.4057	0.4137	1.6228	1.6548
4	26.5136	26.5106	26.9285	26.8986	0.4149	0.3880	1.6596	1.5520
5	26.2989	26.3145	26.6907	26.6912	0.3918	0.3767	1.5672	1.5068
6	26.3116	26.4659	26.7077	26.8445	0.3961	0.3786	1.5844	1.5144

Table 79. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4807	26.4738	31.8879	26.8777	0.4072	0.4039	1.6288	1.6156
2	31.4548	26.4551	31.8285	26.8544	0.3737	0.3993	1.4948	1.5972
3	31.4306	26.3295	31.8175	26.7271	0.3869	0.3976	1.5476	1.5904
4	26.2740	26.3534	26.6751	26.7448	0.4011	0.3914	1.6044	1.5656
5	26.4450	26.3364	26.8257	26.7161	0.3807	0.3797	1.5228	1.5188
6	26.5222	26.4388	26.9003	26.8328	0.3781	0.3940	1.5124	1.5760

Table 80. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3964	26.3836	31.7869	26.8033	0.3905	0.4197	1.5620	6.2480
2	31.4060	26.4149	31.6722	26.8120	0.2662	0.3971	1.0648	4.2592
3	31.2427	26.2788	31.4675	26.6312	0.2248	0.3524	0.8992	3.5968
4	26.3794	26.3839	26.6176	26.7438	0.2382	0.3599	0.9528	3.8112
5	26.3123	31.1467	26.5489	31.4883	0.2366	0.3416	0.9464	3.7856
6	26.2857	26.5380	26.5393	26.8900	0.2536	0.3520	1.0144	4.0576

Table 81. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4.at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3725	26.3130	26.7075	26.7001	0.3350	0.3871	1.3400	1.5484
2	31.3722	26.3281	31.5590	26.5840	0.1868	0.2559	0.7472	1.0236
3	26.4461	26.2999	26.6202	26.5386	0.1741	0.2387	0.6964	0.9548
4	31.4410	31.3849	31.5836	31.6211	0.1426	0.2362	0.5704	0.9448
5	26.3591	26.3524	26.5398	26.5930	0.1807	0.2406	0.7228	0.9624
6	26.4838	31.3867	26.6697	31.6200	0.1859	0.2333	0.7436	0.9332

Table 82. Suspended sediment concentration for high velocity gradient flocculation duplicate run F4.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.5315	26.8034	0.2719	1.0876
2	31.4005	31.7605	0.3600	1.4400
3	26.4745	26.6649	0.1904	0.7616
4	26.4073	26.5863	0.1790	0.7160
5	31.3843	31.5750	0.1907	0.7628
6	26.3135	26.5230	0.2095	0.8380

Table 83. Mass of the sediment settled in the trays for high velocity gradient flocculation run duplicate F4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.15	398.20	2.05
2	760.55	784.10	23.55
3	760.00	783.30	23.30
4	760.20	787.20	27.00
5	1519.25	1518.15	-
6	1518.65	1585.05	66.40
7	1520.10	1661.75	141.65
8	1520.20	1795.35	275.15
9	1519.85	1857.35	337.50
10	1520.20	1770.20	250.00
11	1520.60	1675.80	155.20

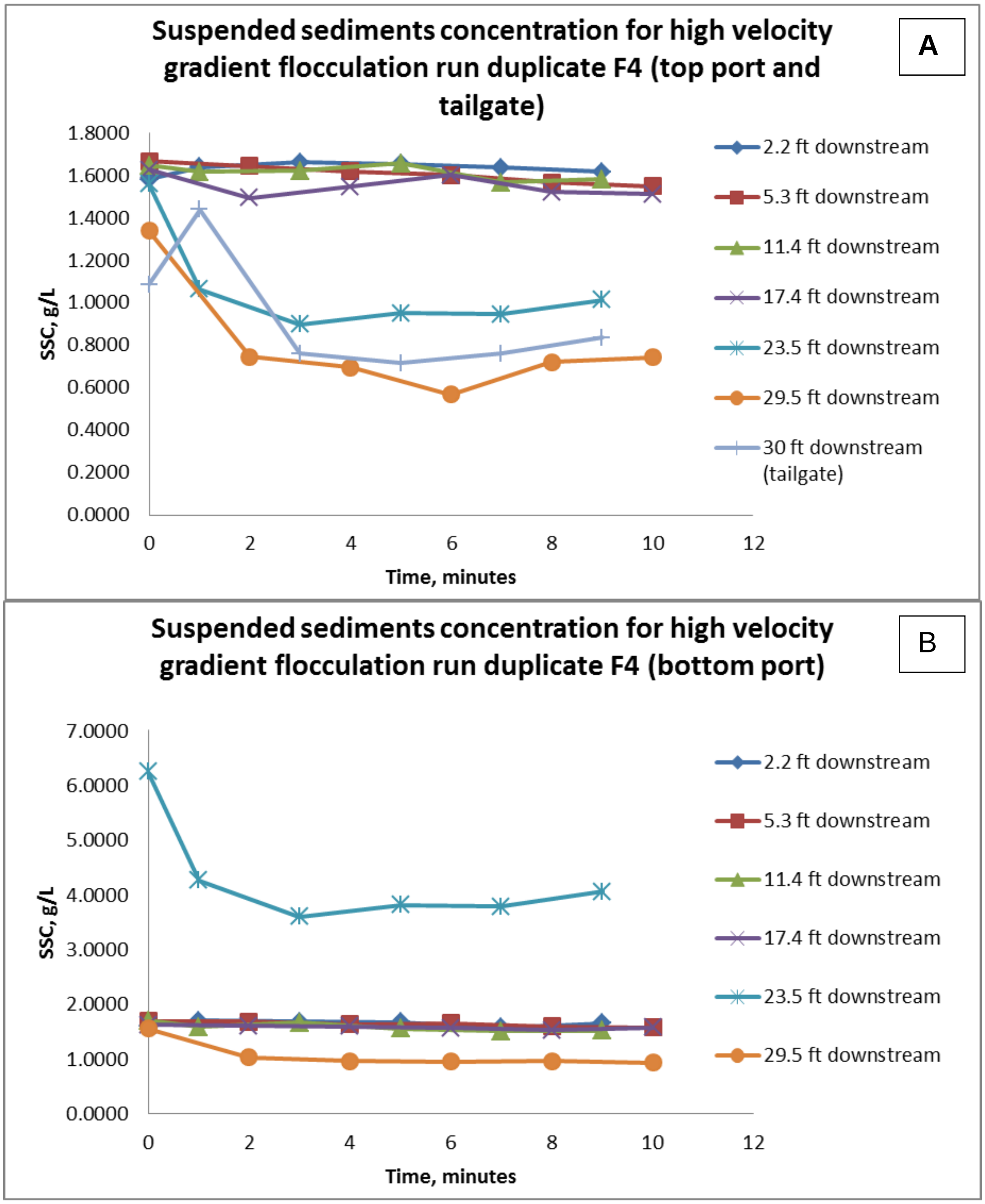


Figure 30. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

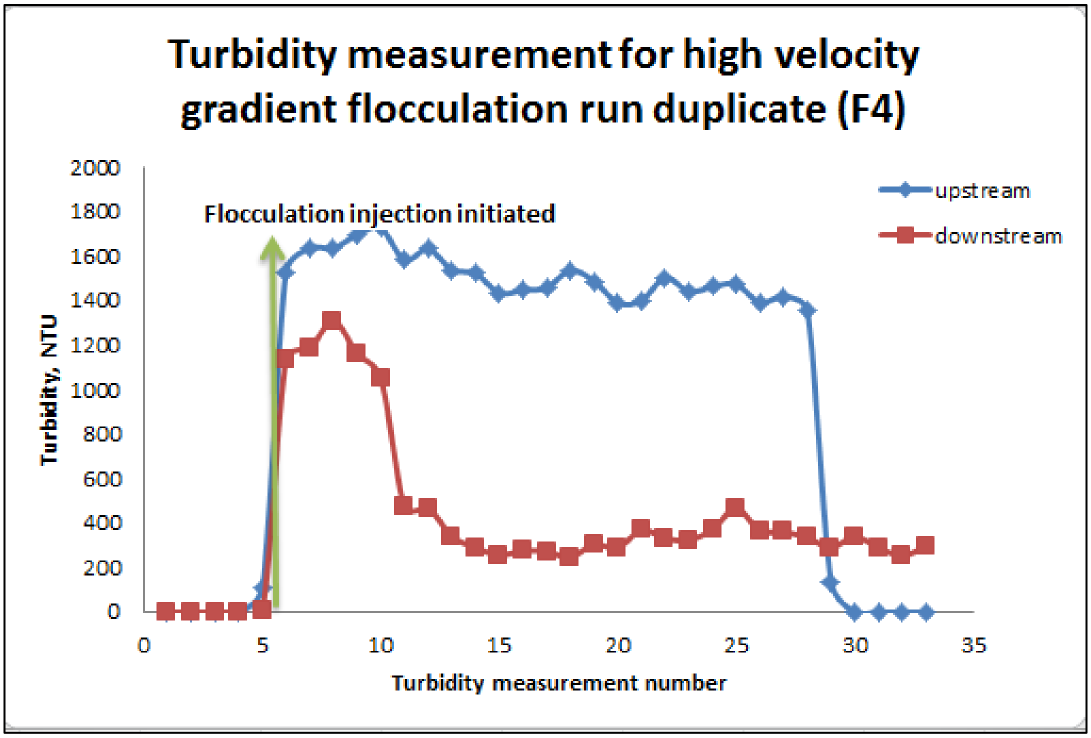


Figure 31. Upstream and downstream turbidity for high velocity gradient flocculation run duplicate F4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port A Low Velocity Gradient Flocculation Run Triplicate (F5)</u>

The speed of the oscillating grids was set to 99 rpm. Tables 84 to 90 show the data for the concentration of the suspended sediments, and Table 91 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 32 shows the graph of the suspended sediment concentration, and Figure 33 shows the graph of the upstream and downstream turbidity.

Table 84. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	26.2880	26.3892	26.6268	26.8253	0.3388	0.4361	1.3552	1.7444
2	26.3932	26.3861	26.8022	26.8403	0.4090	0.4542	1.6360	1.8168
3	26.3855	26.4151	26.7111	26.8221	0.3256	0.4070	1.3024	1.6280
4	26.3552	26.2612	26.7448	26.6709	0.3896	0.4097	1.5584	1.6388
5	26.4056	26.3075	26.7813	26.7028	0.3757	0.3953	1.5028	1.5812
6	26.4412	26.3966	26.8736	26.8226	0.4324	0.4260	1.7296	1.7040

Table 85. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	26.2993	26.2464	26.7524	26.7094	0.4531	0.4630	1.8124	1.8520
2	26.2818	26.2382	26.6776	26.6438	0.3958	0.4056	1.5832	1.6224
3	26.3926	26.4295	26.7519	26.8066	0.3593	0.3771	1.4372	1.5084
4	26.3838	26.4484	26.7428	26.8273	0.3590	0.3789	1.4360	1.5156
5	26.3474	26.4252	26.7491	26.8551	0.4017	0.4299	1.6068	1.7196
6	26.5029	26.3862	26.9246	26.8106	0.4217	0.4244	1.6868	1.6976

Table 86. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4509	26.5048	26.8364	26.9107	0.3855	0.4059	1.5420	1.6236
2	26.3081	26.3928	26.7308	26.8162	0.4227	0.4234	1.6908	1.6936
3	26.3378	26.4041	26.7255	26.8008	0.3877	0.3967	1.5508	1.5868
4	26.2848	26.4069	26.6585	26.7662	0.3737	0.3593	1.4948	1.4372
5	26.4103	26.4431	26.7624	26.7955	0.3521	0.3524	1.4084	1.4096
6	26.3966	26.2626	26.8148	26.6410	0.4182	0.3784	1.6728	1.5136

Table 87. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2949	26.2581	26.7075	26.6641	0.4126	0.4060	1.6504	1.6240
2	26.2842	26.3795	26.5402	26.7931	0.2560	0.4136	1.0240	1.6544
3	26.4183	26.4233	26.7373	26.7751	0.3190	0.3518	1.2760	1.4072
4	26.3613	26.4271	26.6781	26.7703	0.3168	0.3432	1.2672	1.3728
5	26.2875	26.3470	26.6466	26.7061	0.3591	0.3591	1.4364	1.4364
6	26.3924	26.3916	26.7185	26.7730	0.3261	0.3814	1.3044	1.5256

Table 88. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2473	26.4398	26.6272	26.8256	0.3799	0.3858	1.5196	6.0784
2	26.2594	26.3081	26.4963	26.6405	0.2369	0.3324	0.9476	3.7904
3	26.3785	26.3024	26.6711	26.4961	0.2926	0.1937	1.1704	4.6816
4	26.3125	26.4089	26.5015	26.6947	0.1890	0.2858	0.7560	3.0240
5	26.3090	26.4083	26.6172	26.5919	0.3082	0.1836	1.2328	4.9312
6	26.3429	26.3161	26.6304	26.4946	0.2875	0.1785	1.1500	4.6000

Table 89. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2567	26.4938	26.5638	26.8250	0.3071	0.3312	1.2284	1.3248
2	26.2902	26.4874	26.4856	26.7360	0.1954	0.2486	0.7816	0.9944
3	26.3800	26.2797	26.5529	26.4952	0.1729	0.2155	0.6916	0.8620
4	26.2831	26.4396	26.4500	26.6452	0.1669	0.2056	0.6676	0.8224
5	26.3932	26.4159	26.5542	26.6098	0.1610	0.1939	0.6440	0.7756
6	26.4208	26.4433	26.5773	26.6375	0.1565	0.1942	0.6260	0.7768

Table 90. Suspended sediment concentration for low velocity gradient flocculation triplicate run F5 at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.2851	26.5156	0.2305	0.9220
2	26.3868	26.7566	0.3698	1.4792
3	26.3795	26.5670	0.1875	0.7500
4	26.3922	26.5713	0.1791	0.7164
5	26.3817	26.5543	0.1726	0.6904
6	26.2660	26.4263	0.1603	0.6412

Table 91. Mass of the sediment settled in the trays for low velocity gradient flocculation run triplicate F5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	74.65	78.15	3.50
2	74.45	97.15	22.70
3	66.75	94.05	27.30
4	70.45	110.75	40.30
5	72.60	143.55	70.95
6	140.55	322.55	182.00
7	140.38	472.95	332.57
8	139.10	372.00	232.90
9	141.50	458.50	317.00
10	141.25	444.30	303.05
11	136.00	283.90	147.90

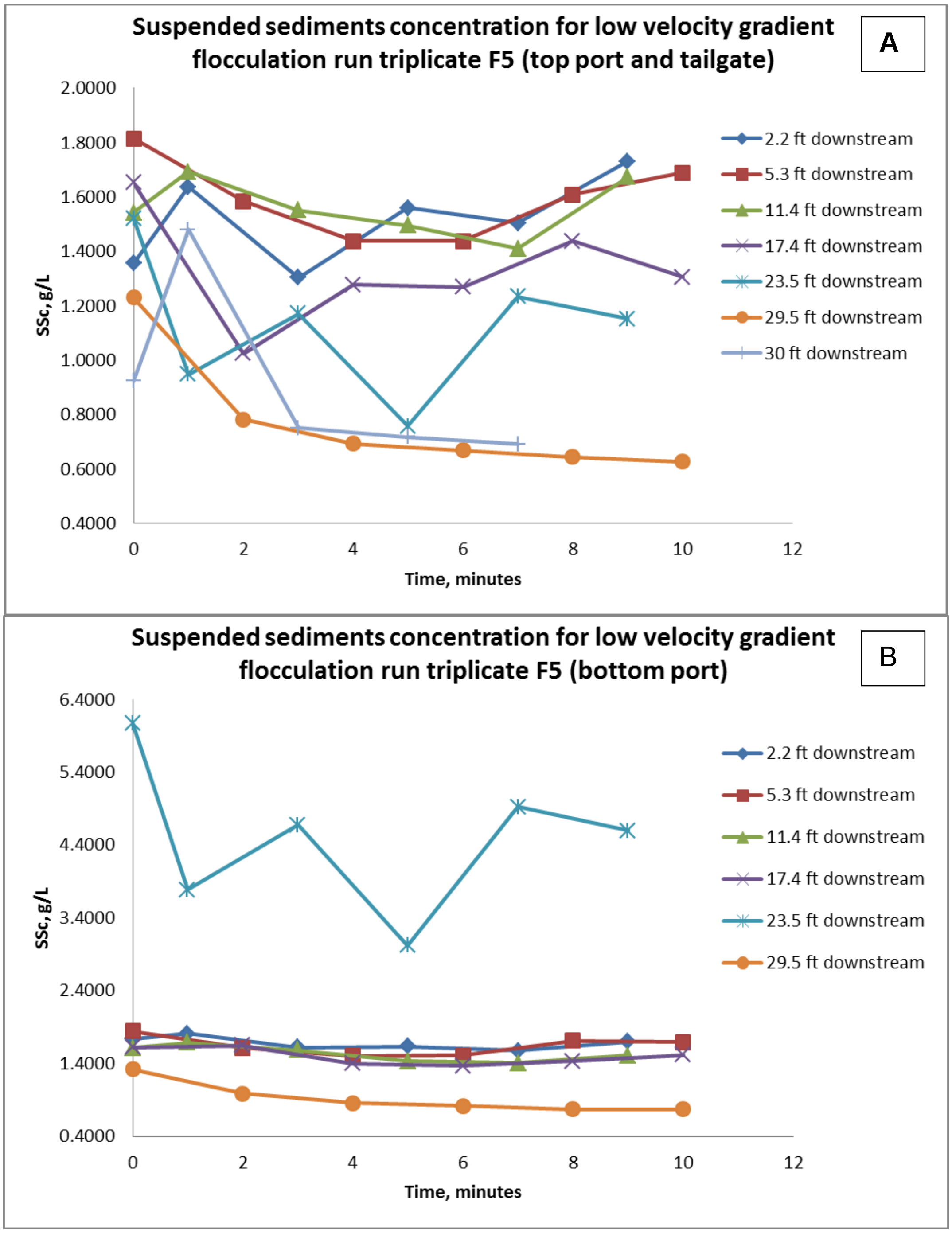


Figure 32. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

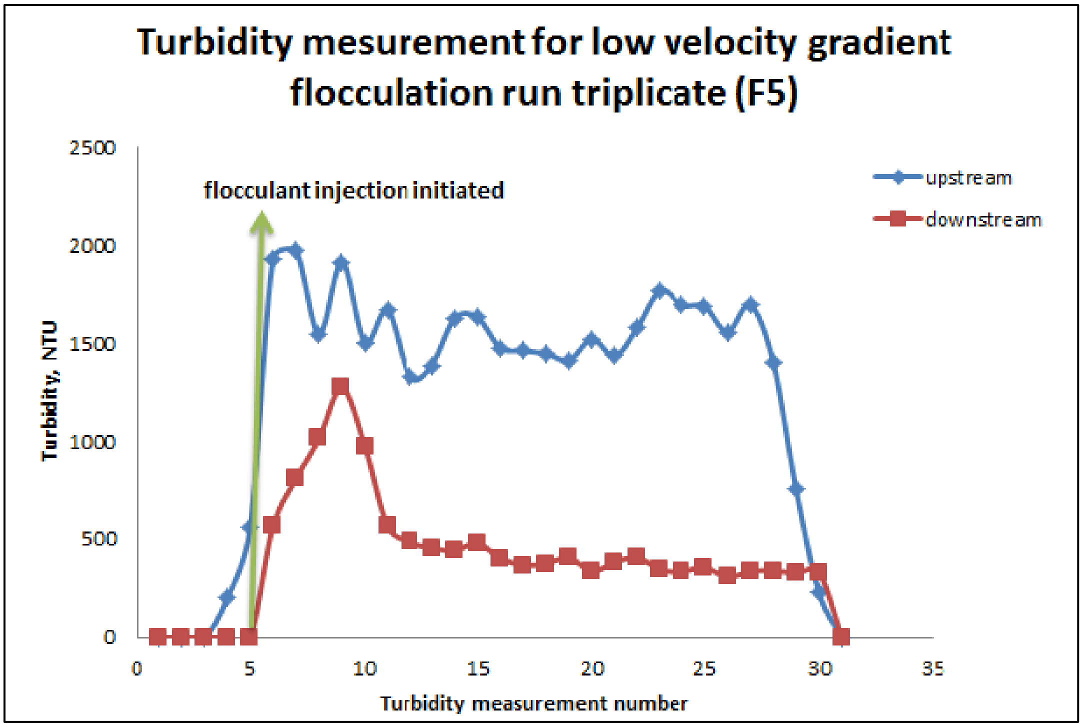


Figure 33. Upstream and downstream turbidity for low velocity gradient flocculation run triplicate F5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Port A High Velocity Gradient Flocculation Run Triplicate (F6)</u>

The speed of the oscillating grids was set to 148 rpm. Tables 92 to 98 show the data for the concentration of the suspended sediments, and Table 99 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 34 shows the graph of the suspended sediment concentration, and Figure 35 shows the graph of the upstream and downstream turbidity.

Table 100 shows the value of the stickiness coefficient found using the excel sheet model, and Figure 36 shows the trapping efficiencies for the Port A soil.

Table 92. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at Station 1.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4876	31.7536	31.5472	31.7847	0.0596	0.0311	0.2384	0.1244
2	31.3184	31.4786	-	-	-	-	-	-
3	31.4596	31.4565	31.7337	31.7400	0.2741	0.2835	1.0964	1.1340
4	31.3664	31.1868	31.9044	31.7204	0.5380	0.5336	2.1520	2.1344
5	31.4820	31.3947	31.9174	31.8222	0.4354	0.4275	1.7416	1.7100
6	31.5342	31.2060	31.9630	31.6260	0.4288	0.4200	1.7152	1.6800

Table 93. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at Station 2.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5045	31.4264	31.8307	31.8478	0.3262	0.4214	1.3048	1.6856
2	31.4558	31.3527	31.7660	31.7525	0.3102	0.3998	1.2408	1.5992
3	31.4221	31.4630	31.7160	31.8023	0.2939	0.3393	1.1756	1.3572
4	31.4896	31.3627	31.9383	31.8245	0.4487	0.4618	1.7948	1.8472
5	31.4148	31.3824	31.8319	31.7970	0.4171	0.4146	1.6684	1.6584
6	31.4710	31.4572	31.8816	31.8716	0.4106	0.4144	1.6424	1.6576

Table 94. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at Station 3.

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3274	31.3760	31.6540	31.7990	0.3266	0.4230	1.3064	1.6920
2	31.4158	31.3721	-	-	-	-	-	-
3	31.3608	31.3906	31.7443	31.7753	0.3835	0.3847	1.5340	1.5388
4	31.1584	31.5177	31.6045	31.8704	0.4461	0.3527	1.7844	1.4108
5	31.4300	31.4444	31.8417	31.8576	0.4117	0.4132	1.6468	1.6528
6	31.4048	31.1565	31.7918	31.5552	0.3870	0.3987	1.5480	1.5948

Table 95. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.6964	31.4144	31.8905	31.8048	0.1941	0.3904	0.7764	1.5616
2	31.3938	31.3690	31.5765	31.5769	0.1827	0.2079	0.7308	0.8316
3	31.3753	31.4182	31.6653	31.7268	0.2900	0.3086	1.1600	1.2344
4	31.3662	31.3741	31.6236	31.7663	0.2574	0.3922	1.0296	1.5688
5	31.3324	31.6711	31.5150	31.8449	0.1826	0.1738	0.7304	0.6952
6	31.3658	31.3865	31.6667	31.7575	0.3009	0.3710	1.2036	1.4840

Table 96. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4626	31.5189	31.7700	31.7965	0.3074	0.2776	1.2296	4.9184
2	31.4804	31.3852	-	-	-	-	-	-
3	31.4125	31.4158	31.5778	31.6724	0.1653	0.2566	0.6612	2.6448
4	31.5397	31.4163	31.7439	31.7189	0.2042	0.3026	0.8168	3.2672
5	31.6044	31.5710	31.7493	31.7304	0.1449	0.1594	0.5796	2.3184
6	31.2437	31.5492	31.4436	31.8232	0.1999	0.2740	0.7996	3.1984

Table 97. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3914	31.5187	31.6981	31.7758	0.3067	0.2571	1.2268	1.0284
2	31.2508	31.4060	31.4407	31.6883	0.1899	0.2823	0.7596	1.1292
3	31.4668	31.5366	31.6353	31.7603	0.1685	0.2237	0.6740	0.8948
4	31.3683	31.4563	31.5536	31.6924	0.1853	0.2361	0.7412	0.9444
5	31.5122	31.4139	31.6907	31.6427	0.1785	0.2288	0.7140	0.9152
6	26.3254	31.4122	26.5054	31.6342	0.1800	0.2220	0.7200	0.8880

Table 98. Suspended sediment concentration for high velocity gradient flocculation triplicate run F6 at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment conc g/L
1	31.4147	31.6336	0.2189	0.8756
2	31.2124	-	-	-
3	31.4835	31.6647	0.1812	0.7248
4	31.3978	31.5790	0.1812	0.7248
5	31.4850	31.6946	0.2096	0.8384
6	31.4054	31.5835	0.1781	0.7124

Table 99. Mass of the sediment settled in the trays for high velocity gradient flocculation run triplicate F6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	72.95	78.35	5.40
2	66.80	102.60	35.80
3	72.20	111.30	39.10
4	72.95	130.90	57.95
5	66.70	171.96	105.26
6	136.25	326.00	189.75
7	142.20	405.15	262.95
8	144.20	407.50	263.30
9	147.55	353.30	205.75
10	143.75	290.00	146.25
11	143.05	247.70	104.65

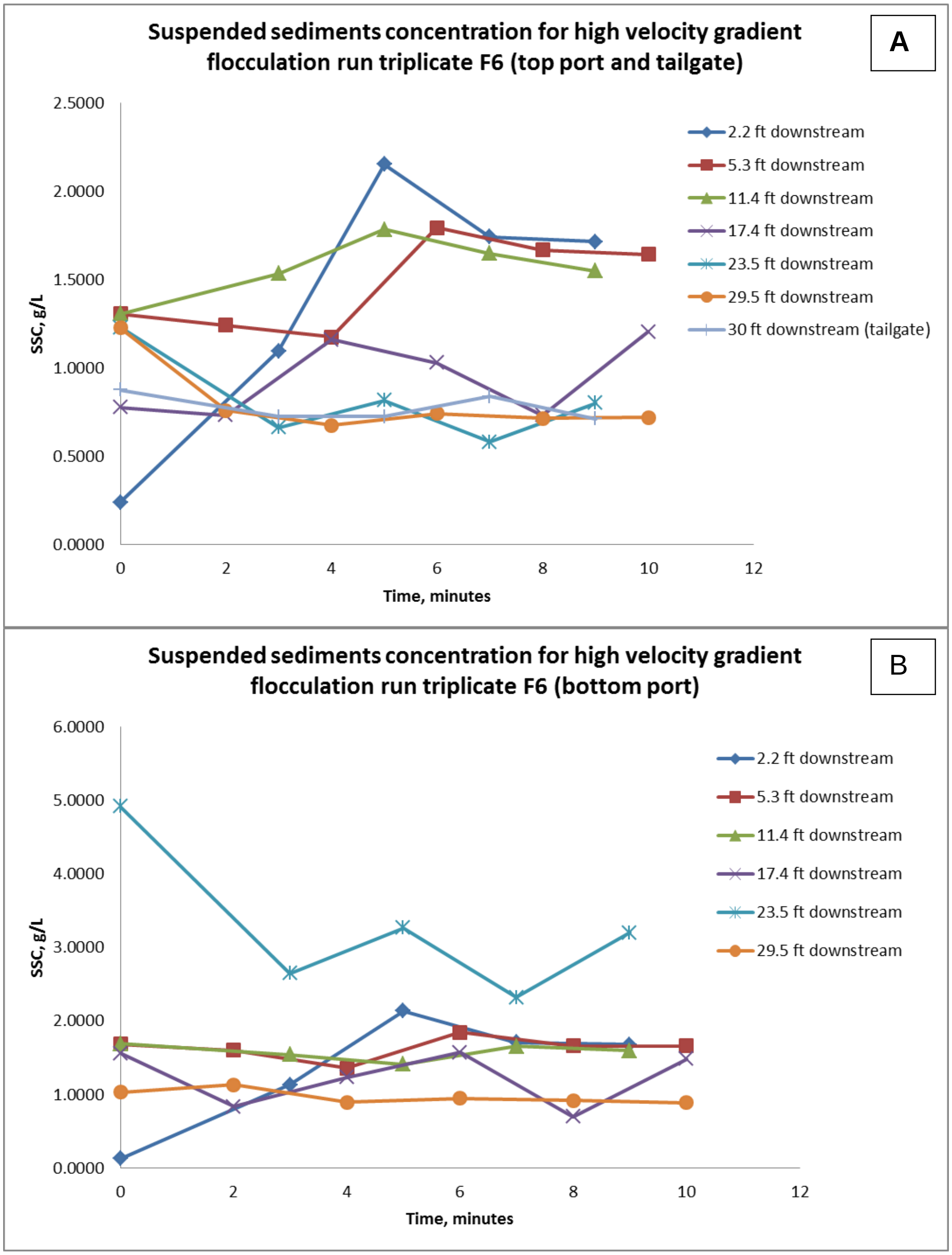


Figure 34. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

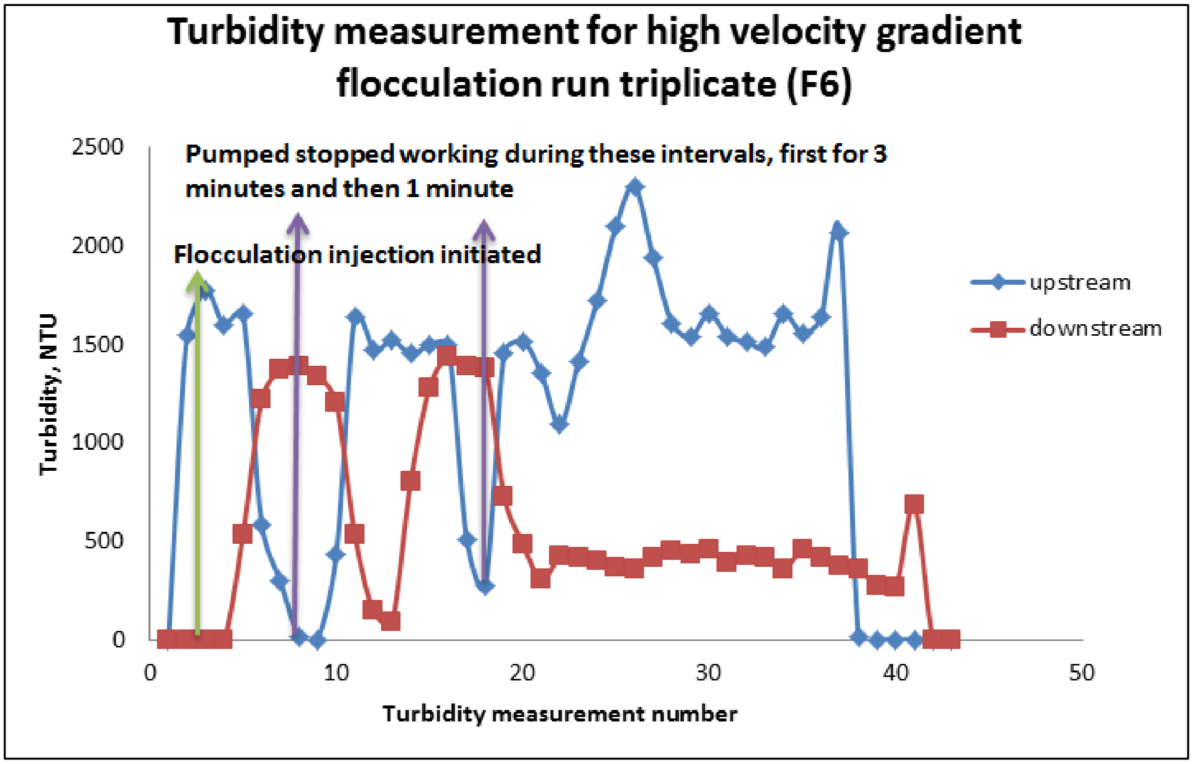


Figure 35. Upstream and downstream turbidity for high velocity gradient flocculation run triplicate F6. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

Table 100. Values of the stickiness coefficient α for the Pacolet soil (F: Flocculation run; Number: Experiment run number).

Low Velocity Gradient Run	High Velocity Gradient Run
F1: α= 0.38	F2: α= 0.55
F3 (duplicate): α= 0.62	F4 (duplicate): α= 0.64
F5 (triplicate): α=0.84	F6 (triplicate): α= 0.71

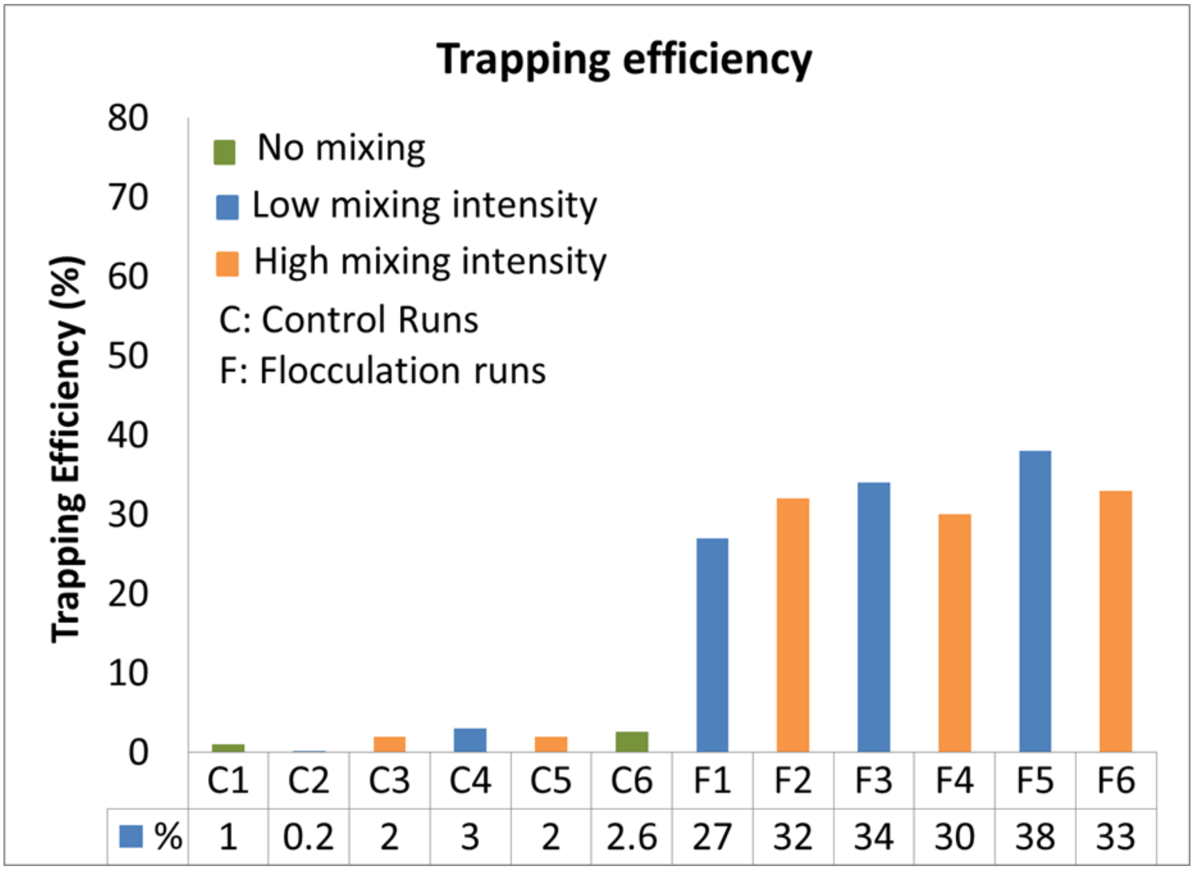


Figure 36. Trapping efficiencies for Port A soil for each of the twelve runs

Data Analysis for Port B Soil

In the following section, data for the suspended sediment concentration and the flocculation constants for the Port B soil are presented. The summary of all the experimental runs done on Pacolet soil is presented in Table 101.

Table 101. Summary of the experimental runs done on Port B soil ('-' indicates that no data available; NA: Not Applicable).

Run No.	Description	Oscillation speed (rpm)	Velocity gradient (sec^{-1})	Sediment flow rate (l/min)	Incoming sediment concentration (g/l)	Flow rate of water (l/min)	Flocculant concentration (g/L)
C1	Control Run without agitation	0	1.57	4.92	53.42	170	NA
C2	Low velocity gradient control run	99	104	5.94	52.11	170	NA
C3	Control Run without agitation duplicate	0	1.57	6.28	49.58	170	NA
C4	Low velocity gradient control run duplicate	99	104	10.87	21.33	171	NA
C5	High velocity gradient control run	148	134	17.0	23.85	220.3	NA
C6	High velocity gradient control run duplicate	148	134	16.65	22.86	186.7	NA
F1	Low velocity gradient flocculation run	99	104	13.25	20.57	170	0.015
F2	High velocity gradient flocculation run	148	134	14.27	21.01	152.91	0.015
F3	Low velocity gradient flocculation run duplicate	99	104	14.95	19.79	192.00	0.015
F4	High velocity gradient flocculation run duplicate	148	134	12.06	23.94	203.2	0.015
F5	Low velocity gradient flocculation run triplicate	99	104	13.08	23.85	150.1	0.015
F6	High velocity gradient flocculation run triplicate	148	134	13.08	23.85	203.1	0.015

Port B Control Run without the Agitation C1

Tables 102 to 108 shows the sediment concentration measured all the six stations and the tailgate. Table 109 shows the mass of the sediment that settled in the trays at the bottom of the flume. Figure 37 shows the concentration of the sediment measured at the top and bottom ports, and Figure 38 shows the graph of the upstream and downstream turbidity measured throughout the run.

Table 102. Suspended sediment concentration for control run without agitation C1 at Station 1 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3963	26.4396	26.8023	26.8350	0.4060	0.3954	1.6240	1.5816
2	26.4029	26.4057	26.8841	26.9980	0.4812	0.5923	1.9248	2.3692
3	26.5528	26.6043	26.8215	26.6798	0.2687	0.0755	1.0748	0.3020
4	26.4519	26.4322	26.7766	26.8524	0.3247	0.4202	1.2988	1.6808
5	26.4882	26.5059	26.8023	26.9278	0.3141	0.4219	1.2564	1.6876
6	26.5382	26.3719	26.8013	27.0619	0.2631	0.6900	1.0524	2.7600
7	26.3794	26.5148	26.8695	26.9820	0.4901	0.4672	1.9604	1.8688
8	26.4050	26.4099	26.9870	26.8576	0.5820	0.4477	2.3280	1.7908

Table 103. Suspended sediment concentration for control run without agitation C1 at Station 2 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4248	26.5476	26.7930	26.8317	0.3682	0.2841	1.4728	1.1364
2	26.4861	26.5843	26.7872	26.8118	0.3011	0.2275	1.2044	0.9100
3	26.3919	26.3636	27.0004	27.0834	0.6085	0.7198	2.4340	2.8792
4	26.3394	26.3981	26.7998	26.8293	0.4604	0.4312	1.8416	1.7248
5	26.4147	26.5105	26.8354	26.9152	0.4207	0.4047	1.6828	1.6188
6	26.3801	26.5628	26.9813	26.8142	0.6012	0.2514	2.4048	1.0056
7	26.4344	26.5097	26.8424	26.9916	0.4080	0.4819	1.6320	1.9276
8	26.6043	26.4232	26.8649	26.8823	0.2606	0.4591	1.0424	1.8364

Table 104. Suspended sediment concentration for control run without agitation C1 at Station 3 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.5610	26.5258	26.8529	27.0163	0.2919	0.4905	1.1676	1.9620
2	26.4003	26.6103	26.7475	26.9923	0.3472	0.3820	1.3888	1.5280
3	26.5779	26.3527	27.0268	26.7906	0.4489	0.4379	1.7956	1.7516
4	26.4603	26.3911	26.9242	26.8313	0.4639	0.4402	1.8556	1.7608
5	26.3675	26.3872	26.7439	26.8058	0.3764	0.4186	1.5056	1.6744
6	26.3884	26.5141	26.8055	26.9635	0.4171	0.4494	1.6684	1.7976
7	26.3781	26.4379	26.8962	26.9125	0.5181	0.4746	2.0724	1.8984
8	26.4671	26.5064	26.6968	26.9614	0.2297	0.4550	0.9188	1.8200

Table 105. Suspended sediment concentration for control run without agitation C1 at Station 4 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.4961	26.5258	26.8529	27.0163	0.3568	0.4905	1.4272	1.9620
2	26.3919	26.6103	26.7475	26.9923	0.3556	0.3820	1.4224	1.5280
3	26.6156	26.3527	27.0268	26.7906	0.4112	0.4379	1.6448	1.7516
4	26.5126	26.3911	26.9242	26.8313	0.4116	0.4402	1.6466	1.7608
5	26.3682	26.3872	26.7439	26.8058	0.3757	0.4186	1.5028	1.6744
6	26.4000	26.5141	26.8055	26.9635	0.4055	0.4494	1.6220	1.7976
7	26.4635	26.4379	26.8962	26.9125	0.4327	0.4746	1.7308	1.8984
8	26.2661	26.5064	26.6968	26.9614	0.4307	0.4550	1.7228	1.8200

Table 106. Suspended sediment concentration for control run without agitation C1 at Station 5 (‘-‘ indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.4168	26.5092	26.7494	26.9746	0.3326	0.4654	1.3304	1.8616
2	26.4640	26.5109	26.8262	26.9359	0.3622	0.4250	1.4488	1.7000
3	26.4278	26.4205	26.7902	26.8028	0.3624	0.3823	1.4496	1.5292
4	26.6131	26.5300	27.0202	26.9613	0.4071	0.4313	1.6284	1.7252
5	26.4088	26.5204	26.8492	26.9560	0.4404	0.4356	1.7616	1.7424
6	26.4703	26.4612	26.8447	26.8708	0.3744	0.4096	1.4976	1.6384
7	26.4906	26.5374	26.9187	26.9908	0.4281	0.4534	1.7124	1.8136
8	26.3871	26.6717	26.8139	26.9945	0.4268	0.3228	1.7072	1.2912

Table 107. Suspended sediment concentration for control run without agitation C1 at Station 6 (‘-‘ indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.4991	26.3670	26.6279	26.9600	0.1288	0.5930	0.5152	2.3720
2	26.3643	26.4256	26.7178	26.8221	0.3535	0.3965	1.4140	1.5860
3	26.5638	26.6074	26.9199	26.9861	0.3561	0.3787	1.4244	1.5148
4	26.3948	26.3539	26.7859	26.7713	0.3911	0.4174	1.5644	1.6696
5	26.3902	26.4015	26.7708	26.8357	0.3806	0.4342	1.5224	1.7368
6	26.5262	26.5292	26.8823	26.9176	0.3561	0.3884	1.4244	1.5536
7	26.4708	26.5066	26.8696	26.9461	0.3988	0.4395	1.5952	1.7580
8	26.4086	26.4740	26.8088	26.9162	0.4002	0.4422	1.6008	1.7688

Table 108. Suspended sediment concentration for control run without agitation C1 at tailgate ('-' indicates No data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.4671	26.8689	0.4018	1.6072
2	26.4601	26.8264	0.3663	1.4652
3	26.4525	26.9680	0.5155	2.0620
4	26.5907	26.9511	0.3604	1.4416
5	26.5330	26.8302	0.2972	1.1888
6	26.4465	26.7958	0.3493	1.3972
7	26.3743	26.7900	0.4157	1.6628
8	26.5504	26.9170	0.3666	1.4664

Table 109: Mass of the sediment settled on the trays for the control run without agitation C1

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.00	778.00	18.00
2	760.00	796.00	36.00
3	761.00	804.00	43.00
4	761.00	792.00	31.00
5	760.00	797.00	37.00
6	761.00	796.00	35.00
7	761.00	791.00	30.00
8	760.00	792.00	32.00
9	760.00	793.00	33.00
10	760.00	791.00	31.00

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
11	761.00	792.00	31.00

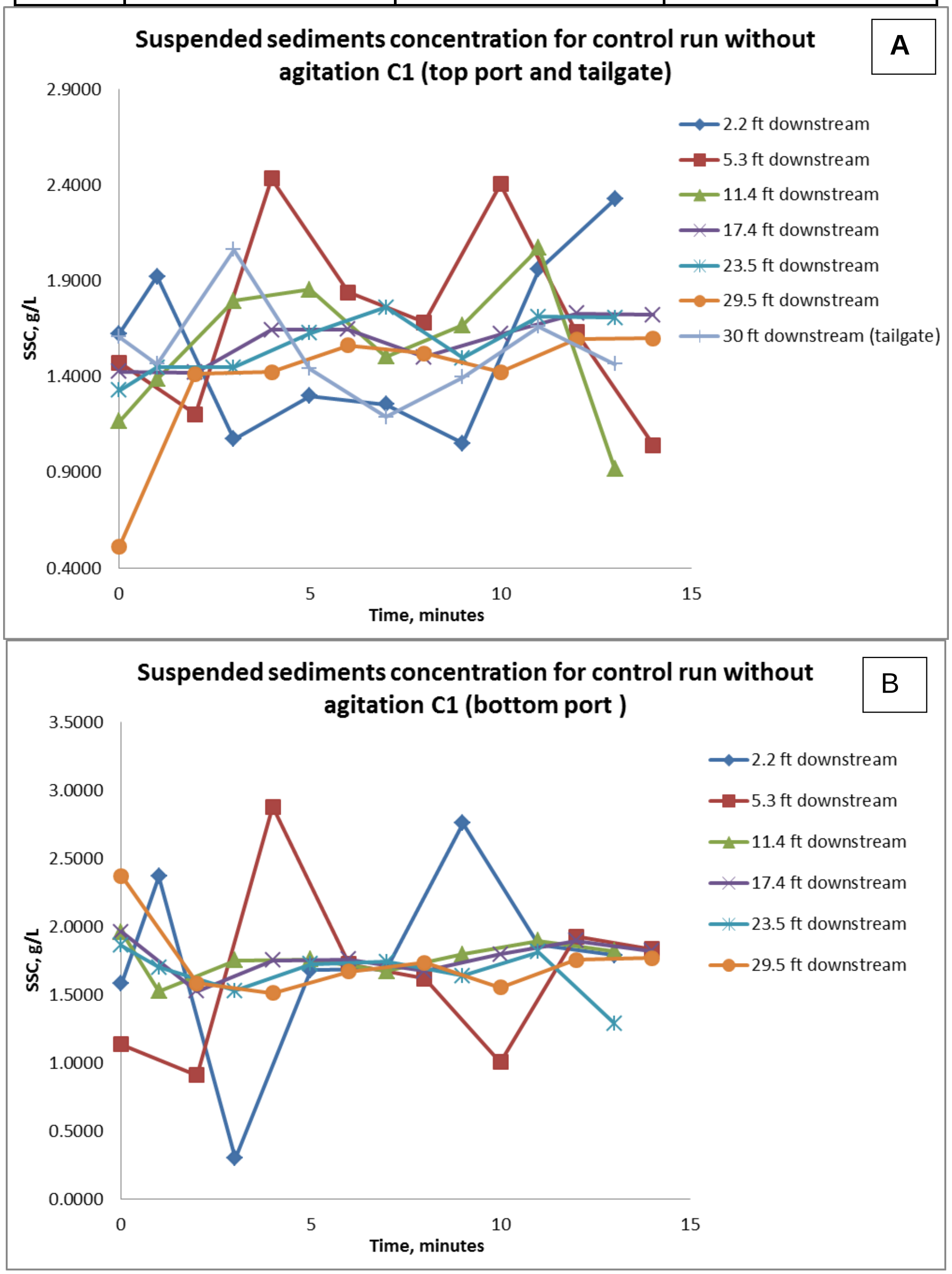


Figure 37. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

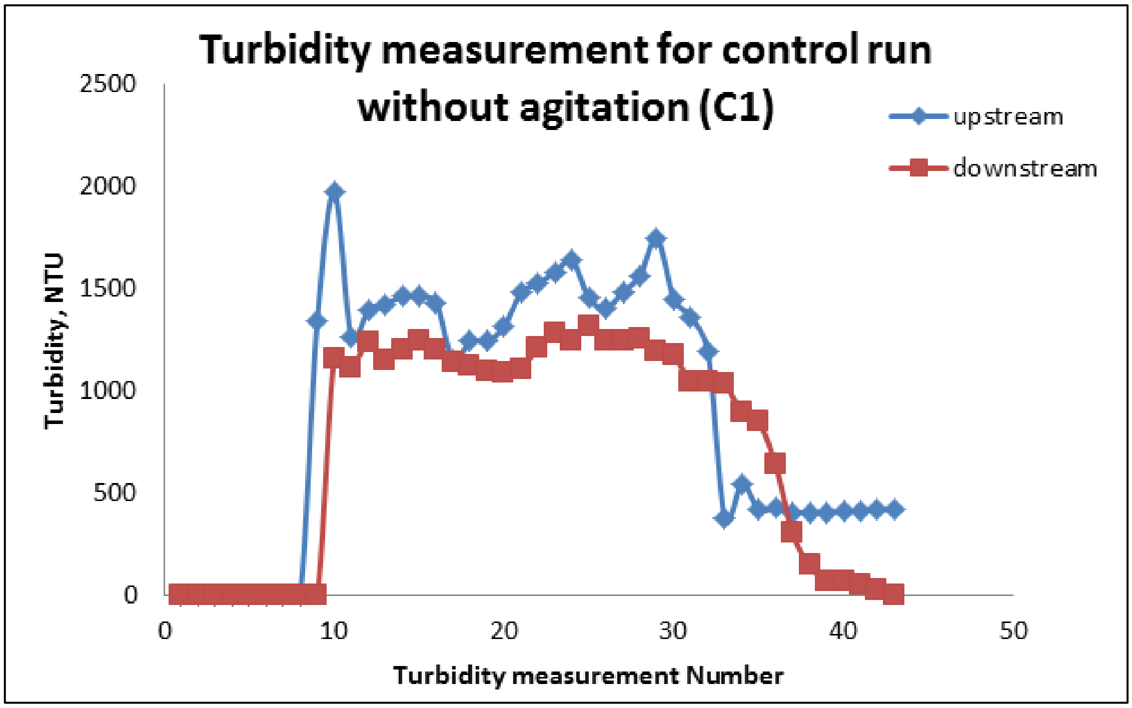


Figure 38. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Port B Low Velocity Gradient Control Run (C2)</u>

Since the nature of the control run with agitation was the same for both soils, the speed of the oscillating grids for this run was set at 99 rpm. Tables 110 to 117 show the data related to the sediment concentration measured at the sampling ports, and mass of the flocculated matter that settled in the trays respectively.

Table 110. Suspended sediment concentration for low velocity gradient control run (C2).at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5480	26.3334	27.1350	26.8350	0.5870	0.5016	2.3480	2.0064
2	26.6087	26.4718	27.1962	26.9980	0.5875	0.5262	2.3500	2.1048
3	26.4913	26.3707	26.9816	26.6798	0.4903	0.3091	1.9612	1.2364
4	26.3349	26.3794	26.8478	26.8524	0.5129	0.4730	2.0516	1.8920
5	26.3661	26.3945	26.8674	26.9278	0.5013	0.5333	2.0052	2.1332
6	26.4195	26.3366	26.9227	27.0619	0.5032	0.7253	2.0128	2.9012
7	26.5399	26.5324	27.0396	26.982	0.4997	0.4496	1.9988	1.7984
8	26.5592	26.3442	27.0701	26.8576	0.5109	0.5134	2.0436	2.0536

Table 111. Suspended sediment concentration for low velocity gradient control run (C2).at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2874	26.4428	26.8885	27.0664	0.6011	0.6236	2.4044	2.4944
2	26.3720	26.4787	26.8923	27.0151	0.5203	0.5364	2.0812	2.1456
3	26.4983	26.4372	27.0155	26.9768	0.5172	0.5396	2.0688	2.1584
4	26.5368	26.5023	27.0427	27.0428	0.5059	0.5405	2.0236	2.1620
5	26.3769	26.3956	26.8801	26.9250	0.5032	0.5294	2.0128	2.1176
6	26.5030	26.3779	27.0111	26.8988	0.5081	0.5209	2.0324	2.0836
7	26.5662	26.3703	27.0707	26.9027	0.5045	0.5324	2.0180	2.1296
8	26.5184	26.5204	27.0273	26.9154	0.5089	0.3950	2.0356	1.5800

Table 112. Suspended sediment concentration for low velocity gradient control run (C2).at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station3	T	B	T	B	T	B	T	B
1	26.4245	26.3934	-	-	-	-	-	-
2	26.3640	26.4145	26.9617	27.0256	0.5977	0.6111	2.3908	2.4444
3	26.4461	26.3968	26.9666	26.9397	0.5205	0.5429	2.0820	2.1716
4	26.3713	26.5817	26.9001	27.1384	0.5288	0.5567	2.1152	2.2268
5	26.4338	26.5098	26.9678	27.0562	0.5340	0.5464	2.1360	2.1856
6	26.5208	26.4946	27.0391	27.0209	0.5183	0.5263	2.0732	2.1052
7	26.4751	26.4128	26.9736	26.9420	0.4985	0.5292	1.9940	2.1168
8	26.3573	26.4852	26.8795	27.0333	0.5222	0.5481	2.0888	2.1924

Table 113. Suspended sediment concentration for low velocity gradient control run (C2).at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.4045	26.3758	26.9807	26.9707	0.5762	0.5949	2.3048	2.3796
2	26.4477	26.6078	27.0233	27.2066	0.5756	0.5988	2.3024	2.3952
3	26.3770	26.5908	26.9003	27.1354	0.5233	0.5446	2.0932	2.1784
4	26.5343	26.3540	27.0510	26.8992	0.5167	0.5452	2.0668	2.1808
5	26.3588	26.3438	26.8704	26.8830	0.5116	0.5392	2.0464	2.1568
6	26.3442	26.6172	26.8547	27.1502	0.5105	0.533	2.0420	2.1320
7	26.3834	26.6281	26.8804	27.1459	0.4970	0.5178	1.9880	2.0712
8	26.5093	26.4817	27.0214	27.0100	0.5121	0.5283	2.0484	2.1132

Table 114. Suspended sediment concentration for low velocity gradient control run (C2).at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.3746	26.4247	26.9050	27.0498	0.5304	0.6251	2.1216	2.5004
2	26.5700	26.5650	27.1112	27.1244	0.5412	0.5594	2.1648	2.2376
3	26.5093	26.4397	26.9921	26.9806	0.4828	0.5409	1.9312	2.1636
4	26.4069	26.3836	26.8608	26.8905	0.4539	0.5069	1.8156	2.0276
5	26.6326	26.5229	27.0848	27.0006	0.4522	0.4777	1.8088	1.9108
6	26.5137	26.4467	26.9781	26.9339	0.4644	0.4872	1.8576	1.9488
7	26.3806	26.5835	26.8471	27.0696	0.4665	0.4861	1.8660	1.9444
8	26.3647	26.6118	26.8195	27.0911	0.4548	0.4793	1.8192	1.9172

Table 115. Suspended sediment concentration for low velocity gradient control run (C2).at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.4103	26.4163	26.7132	26.9620	0.3029	0.5457	1.2116	2.1828
2	26.5851	26.3813	27.1644	26.9814	0.5793	0.6001	2.3172	2.4004
3	26.3970	26.5438	26.8789	27.0263	0.4819	0.4825	1.9276	1.9300
4	26.5850	26.5208	27.0631	26.9978	0.4781	0.4770	1.9124	1.9080
5	26.5137	26.5003	26.9770	26.9956	0.4633	0.4953	1.8532	1.9812
6	26.4290	26.5174	26.8578	27.0313	0.4288	0.5139	1.7152	2.0556
7	26.5395	26.5515	26.9973	27.0313	0.4578	0.4798	1.8312	1.9192
8	26.5869	26.3623	27.0461	26.8414	0.4592	0.4791	1.8368	1.9164

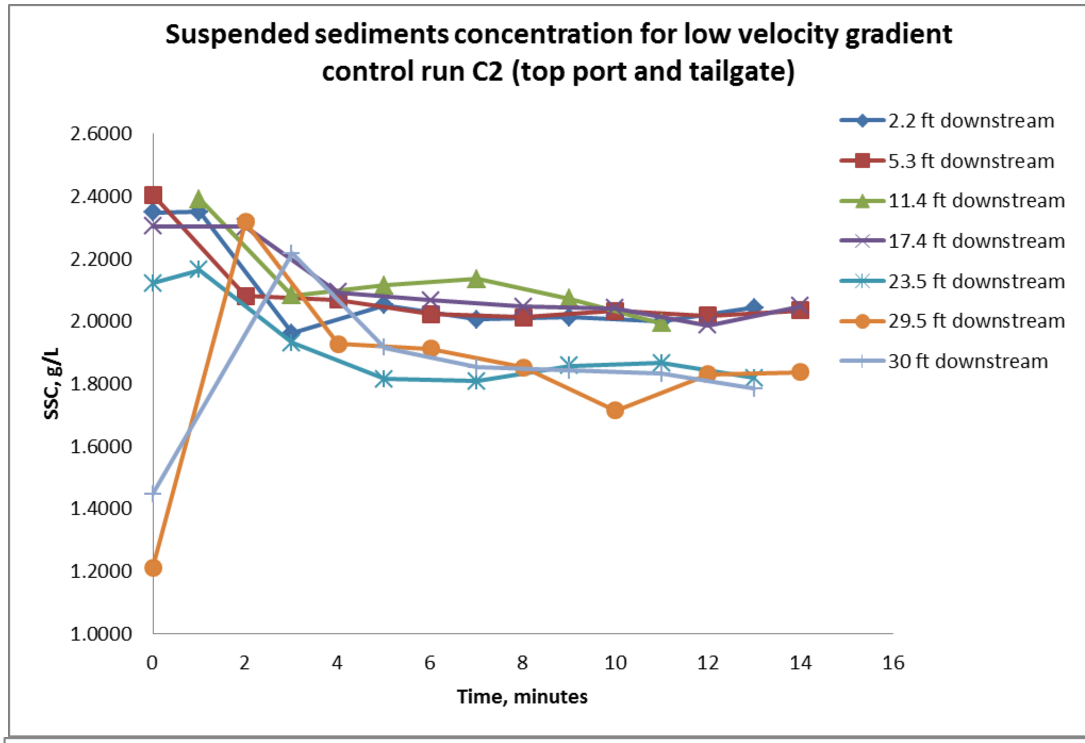
Table 116. Suspended sediment concentration for low velocity gradient control run (C2).at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.5201	26.8819	0.3618	1.4472
2	26.5218	26.0284	-0.4934	-
3	26.3820	26.9362	0.5542	2.2168
4	26.3885	26.8675	0.4790	1.9160
5	26.4889	26.9521	0.4632	1.8528
6	26.3848	26.8454	0.4606	1.8424
7	26.3712	26.8291	0.4579	1.8316
8	26.4103	26.8563	0.4460	1.7840

Table 117. Mass of the sediment settled in the trays for low velocity gradient control run (C2).

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	761.00	769.00	8.00
2	760.00	787.00	27.00
3	760.00	794.00	34.00
4	760.00	798.00	38.00
5	760.00	792.00	32.00
6	761.00	802.00	41.00
7	760.00	790.00	30.00
8	761.00	800.00	39.00
9	760.00	801.00	41.00
10	1521.00	1559.00	38.00
11	760.00	799.00	39.00

Figure 39 below shows the graph of the sediment concentration for this run, and Figure 40 shows the graph of the upstream and downstream turbidity. The oscillating grids stopped working during this test causing a delay of 4 minutes in the run. This can be seen this in Figure 44 from the turbidity readings.



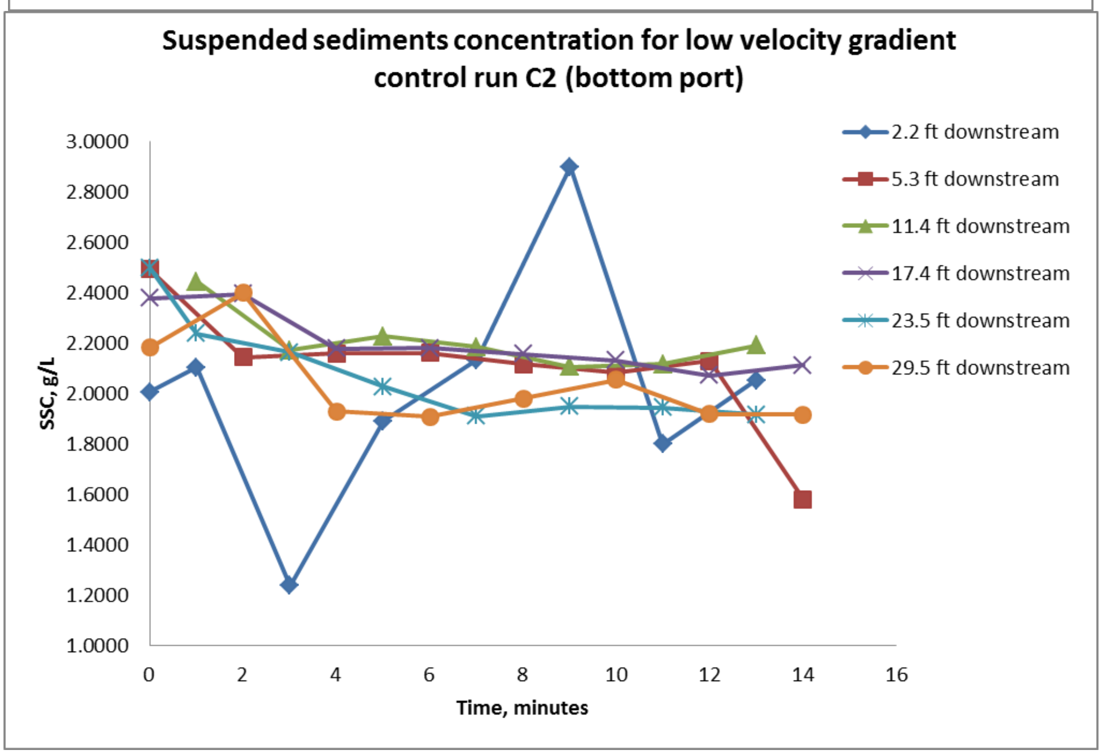


Figure 39. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

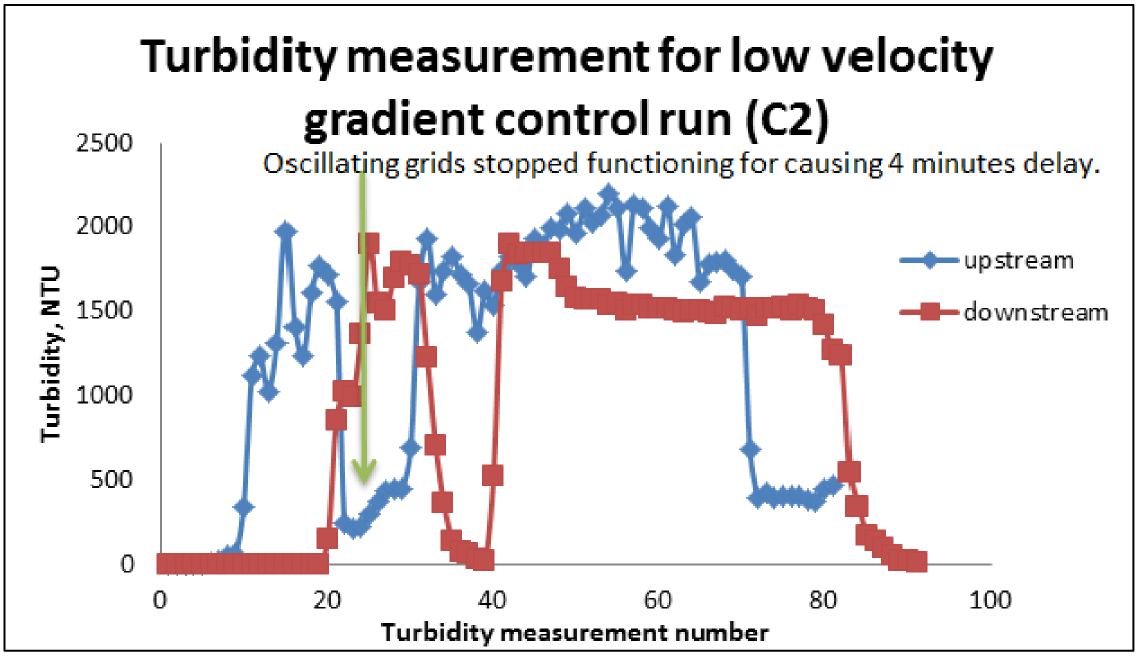


Figure 40. Upstream and downstream turbidity for low velocity gradient control run C2. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

Port B Control Run without agitation duplicate (C3)

Tables 118 to 124 shows the data for the concentration of the suspended sediments, and Table 125 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 41 shows the graph of the suspended sediment concentration.

Table 118. Suspended sediment concentration for control run without agitation duplicate C3 at Station 1('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4484	26.5597	26.9065	26.9323	0.4581	0.3726	1.8324	1.4904
2	26.5410	26.4797	26.8966	26.9102	0.3556	0.4305	1.4224	1.7220
3	26.6419	26.7008	26.9523	26.9803	0.3104	0.2795	1.2416	1.1180
4	26.4083	26.4777	26.8947	26.9240	0.4864	0.4463	1.9456	1.7852
5	26.5991	26.7444	26.9718	27.0313	0.3727	0.2869	1.4908	1.1476
6	26.6164	26.4233	27.0691	26.9042	0.4527	0.4809	1.8108	1.9236
7	26.4564	26.6304	26.9142	27.0513	0.4578	0.4209	1.8312	1.6836
8	26.5637	26.5584	26.9554	26.9464	0.3917	0.3880	1.5668	1.5520

Table 119. Suspended sediment concentration for control run without agitation duplicate C3 at Station 2('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4763	26.5016	26.9092	26.9442	0.4329	0.4426	1.7316	1.7704
2	26.6162	26.6844	26.9513	27.1202	0.3351	0.4358	1.3404	1.7432
3	26.5117	26.4568	26.9479	26.9504	0.4362	0.4936	1.7448	1.9744
4	26.4481	26.4778	26.8988	26.9753	0.4507	0.4975	1.8028	1.9900
5	26.5306	26.6366	26.9460	27.0948	0.4154	0.4582	1.6616	1.8328
6	26.5625	26.6859	26.9296	27.1478	0.3671	0.4619	1.4684	1.8476
7	26.5851	26.6062	26.9598	27.0428	0.3747	0.4366	1.4988	1.7464
8	26.7240	26.5382	27.1190	27.0056	0.3950	0.4674	1.5800	1.8696

Table 120. Suspended sediment concentration for control run without agitation duplicate C3 at Station 3('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4250	26.6507	26.8115	27.0479	0.3865	0.3972	1.5460	1.5888
2	26.4422	26.5897	26.8599	26.9702	0.4177	0.3805	1.6708	1.5220
3	26.6484	26.6343	26.9639	26.9898	0.3155	0.3555	1.2620	1.4220
4	26.5258	26.5772	27.0016	27.0624	0.4758	0.4852	1.9032	1.9408
5	26.4272	26.7346	26.9008	27.0908	0.4736	0.3562	1.8944	1.4248
6	26.4278	26.4574	26.9417	26.9548	0.5139	0.4974	2.0556	1.9896
7	26.4370	26.5148	26.9364	26.9695	0.4994	0.4547	1.9976	1.8188
8	26.5266	26.6753	26.9856	27.0895	0.4590	0.4142	1.8360	1.6568

Table 121. Suspended sediment concentration for control run without agitation duplicate C3 at Station 4('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5938	26.6627	26.9771	27.0262	0.3833	0.3635	1.5332	1.4540
2	26.5429	26.7189	26.8734	27.1293	0.3305	0.4104	1.3220	1.6416
3	26.8108	26.5333	27.0391	26.8088	0.2283	0.2755	0.9132	1.1020
4	26.6379	26.5245	27.0485	26.9778	0.4106	0.4533	1.6424	1.8132
5	26.5281	26.3962	26.9036	26.9755	0.3755	0.5793	1.5020	2.3172
6	26.5715	26.5526	26.9228	27.0880	0.3513	0.5354	1.4052	2.1416
7	26.5618	26.5700	27.0090	27.0374	0.4472	0.4674	1.7888	1.8696
8	26.3596	26.6712	26.8094	27.0918	0.4498	0.4206	1.7992	1.6824

Table 122. Suspended sediment concentration for control run without agitation duplicate C3 at Station 5('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.5363	26.5346	26.8937	27.0097	0.3574	0.4751	1.4296	1.9004
2	26.5996	26.5413	26.9421	27.0203	0.3425	0.4790	1.3700	1.9160
3	26.5442	26.4927	26.9174	26.9384	0.3732	0.4457	1.4928	1.7828
4	26.7810	26.6455	27.1122	27.0674	0.3312	0.4219	1.3248	1.6876
5	26.6563	26.5244	26.9350	27.0976	0.2787	0.5732	1.1148	2.2928
6	26.5882	26.6032	27.0063	27.0282	0.4181	0.4250	1.6724	1.7000
7	26.5861	26.6258	27.0308	27.1115	0.4447	0.4857	1.7788	1.9428
8	26.5167	26.6773	26.9260	27.1053	0.4093	0.4280	1.6372	1.7120

Table 123. Suspended sediment concentration for control run without agitation duplicate C3 at Station 6('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.4328	26.5601	26.8493	26.9859	0.4165	0.4258	1.6660	1.7032
2	26.4971	26.5390	26.8374	26.9181	0.3403	0.3791	1.3612	1.5164
3	26.6734	26.6816	26.9629	27.1130	0.2895	0.4314	1.1580	1.7256
4	26.5372	26.5308	26.8945	26.8855	0.3573	0.3547	1.4292	1.4188
5	26.5051	26.5123	26.8891	26.9415	0.3840	0.4292	1.5360	1.7168
6	26.5897	26.6505	27.0401	27.0763	0.4504	0.4258	1.8016	1.7032
7	26.4822	26.5715	26.9916	27.0582	0.5094	0.4867	2.0376	1.9468
8	26.5155	26.6413	26.9216	27.0332	0.4061	0.3919	1.6244	1.5676

Table 124. Suspended sediment concentration for control run without agitation duplicate C3 at tailgate('-' indicates no data).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.5920	26.8710	0.2790	1.1160
2	26.5096	26.9444	0.4348	1.7392
3	26.5289	26.9396	0.4107	1.6428
4	26.7021	26.9978	0.2957	1.1828
5	26.5800	27.0379	0.4579	1.8316
6	26.5592	26.9352	0.3760	1.5040
7	26.4326	26.8946	0.4620	1.8480
8	26.6383	27.0989	0.4606	1.8424

Table 125. Mass of settled sediments in the trays control run without agitation duplicate C3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.00	769.00	9.00
2	761.00	788.00	27.00
3	761.00	795.00	34.00
4	761.00	786.00	25.00
5	760.00	794.00	34.00
6	762.00	791.00	29.00
7	761.00	786.00	25.00
8	761.00	792.00	31.00
9	761.00	791.00	30.00
10	761.00	791.00	30.00
11	761.00	791.00	30.00

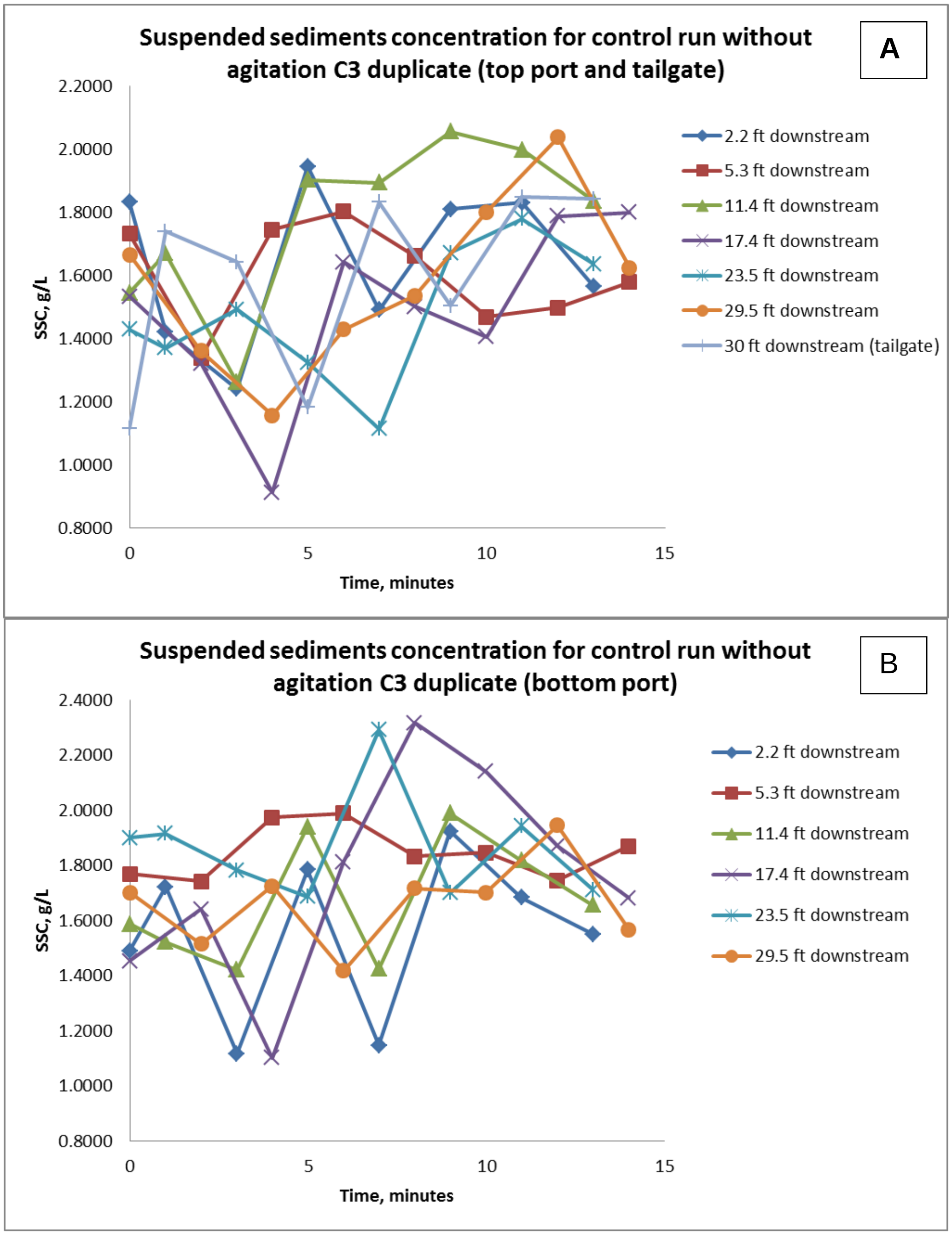


Figure 41. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

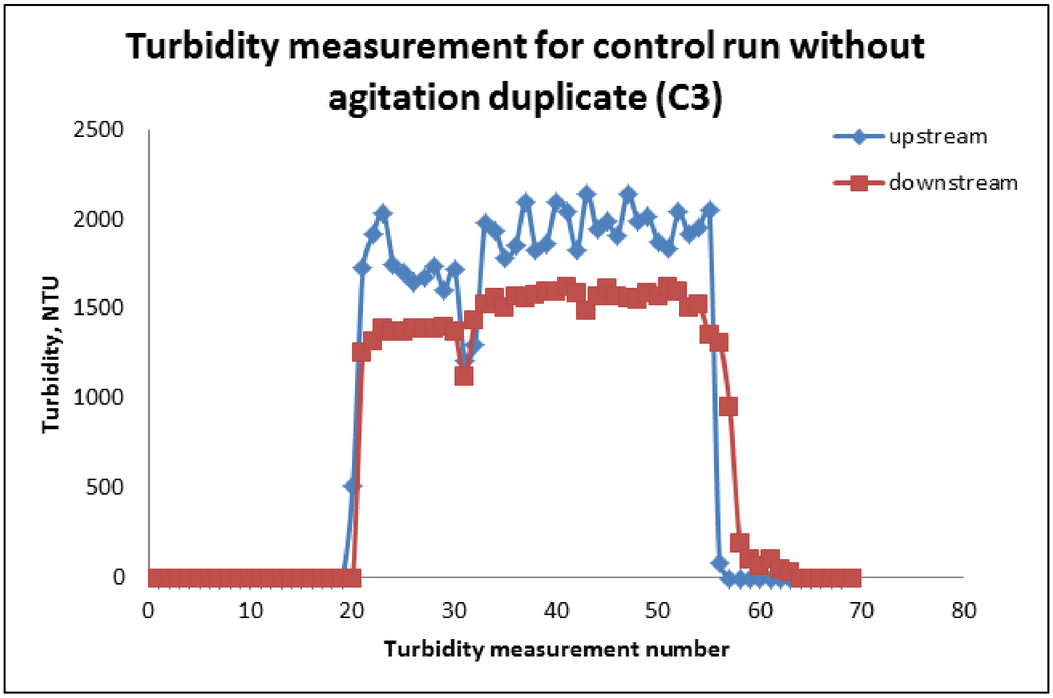


Figure 42. Upstream and downstream turbidity for control run without agitation duplicate C3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Port B Low Velocity Gradient Control Run Duplicate (C4)</u>

The speed of the oscillating grids was set at 99 rpm. Tables 126 to 133 show the data related to the low velocity gradient control run C4, and Figure 43 shows the graph of the suspended sediment concentration. Figure 44 shows the graph of the upstream and downstream turbidity measured for this run.

Table 126. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4654	26.5979	26.8038	26.9519	0.3384	0.3540	1.3536	1.4160
2	26.5832	26.4011	26.8889	26.7626	0.3057	0.3615	1.2228	1.4460
3	26.3732	26.3587	26.7498	26.7520	0.3766	0.3933	1.5064	1.5732
4	26.5417	26.4985	26.8901	26.8360	0.3484	0.3375	1.3936	1.3500
5	26.5489	26.5104	26.8815	26.8227	0.3326	0.3123	1.3304	1.2492
6	26.3556	26.5422	26.8217	26.9823	0.4661	0.4401	1.8644	1.7604
7	26.4774	26.4204	26.8578	26.8489	0.3804	0.4285	1.5216	1.7140
8	26.4471	26.5086	26.7969	26.9206	0.3498	0.4120	1.3992	1.6480

Table 127. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4547	26.5244	26.7813	26.9167	0.3266	0.3923	1.3064	1.5692
2	26.4151	26.4371	26.7687	26.8295	0.3536	0.3924	1.4144	1.5696
3	26.5393	26.5102	26.9241	26.8864	0.3848	0.3762	1.5392	1.5048
4	26.6692	26.6010	26.7145	26.8799	0.0453	0.2789	0.1812	1.1156
5	26.5050	26.5340	26.8317	26.7708	0.3267	0.2368	1.3068	0.9472
6	26.7480	26.3541	26.9160	26.7337	0.1680	0.3796	0.6720	1.5184
7	26.5610	26.6911	26.7146	26.8857	0.1536	0.1946	0.6144	0.7784
8	26.4029	26.4427	26.7471	26.8668	0.3442	0.4241	1.3768	1.6964

Table 128. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.5210	26.7974	26.8011	26.8878	0.0867	0.0904	0.3468	0.3616
2	26.6966	26.5334	26.8590	26.8108	0.1624	0.2774	0.6496	1.1096
3	26.5486	26.5657	26.7363	26.7849	0.1877	0.2192	0.7508	0.8768
4	26.6443	26.5108	26.7244	26.7633	0.0801	0.2525	0.3204	1.0100
5	26.5426	26.5288	26.7388	26.7463	0.1962	0.2175	0.7848	0.8700
6	26.4053	26.3244	26.7106	26.7305	0.3053	0.4061	1.2212	1.6244
7	26.7352	26.4494	26.8747	26.7795	0.1395	0.3301	0.5580	1.3204
8	26.6054	26.7155	26.7092	26.7504	0.1038	0.0349	0.4152	0.1396

Table 129. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.5415	26.4931	26.7197	26.7872	0.1782	0.2941	0.7128	1.1764
2	26.5852	26.6352	26.8260	26.9397	0.2408	0.3045	0.9632	1.2180
3	26.7152	26.5076	26.9329	26.7431	0.2177	0.2355	0.8708	0.9420
4	26.5949	26.5172	26.7967	26.7482	0.2018	0.2310	0.8072	0.9240
5	26.5719	26.5472	26.7879	26.7330	0.2160	0.1858	0.8640	0.7432
6	26.5796	26.7550	26.7302	26.9921	0.1506	0.2371	0.6024	0.9484
7	26.4906	26.6023	26.7241	26.8608	0.2335	0.2585	0.9340	1.0340
8	26.6935	26.6748	26.8859	26.8623	0.1924	0.1875	0.7696	0.7500

Table 130. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4195	26.5484	26.4297	26.5915	0.0102	0.0431	0.0408	0.1632
2	26.4940	26.8636	26.6986	26.8462	0.2046	-0.0174	0.8184	3.2736
3	26.5193	26.7661	26.6930	26.9012	0.1737	0.1351	0.6948	2.7792
4	26.5519	26.6576	26.7238	26.6604	0.1719	0.0028	0.6876	2.7504
5	26.5337	26.6765	26.6684	26.7633	0.1347	0.0868	0.5388	2.1552
6	26.6337	26.6338	26.7601	26.7078	0.1264	0.0740	0.5056	2.0224
7	26.5907	26.7904	26.7670	26.8704	0.1763	0.0800	0.7052	2.8208
8	26.4855	26.6924	26.6918	26.8074	0.2063	0.1150	0.8252	3.3008

Table 131. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4801	26.2891	26.3200	26.4425	-	0.1534	-	0.6136
2	26.4955	26.5156	26.9483	26.9909	0.4528	0.4753	1.8112	1.9012
3	26.2542	26.3795	26.6986	26.8527	0.4444	0.4732	1.7776	1.8928
4	26.2895	26.3421	26.7220	26.8075	0.4325	0.4654	1.7300	1.8616
5	26.2795	26.2975	26.7218	26.7590	0.4423	0.4615	1.7692	1.8460
6	26.2771	26.5177	26.7258	26.9897	0.4487	0.4720	1.7948	1.8880
7	26.3935	26.4339	26.8486	26.9050	0.4551	0.4711	1.8204	1.8844
8	26.4932	26.3764	26.9430	26.8453	0.4498	0.4689	1.7992	1.8756

Table 132. Suspended sediment concentration for low velocity gradient control run duplicate C4.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.4308	26.7230	0.2922	1.1688
2	26.2962	26.7934	0.4972	1.9888
3	26.3586	26.5649	0.2063	0.8252
4	26.5038	26.4587	-	-
5	26.4034	26.5889	0.1855	0.7420
6	26.4425	26.6120	0.1695	0.6780
7	26.4169	26.8827	0.4658	1.8632
8	26.4892	26.9530	0.4638	1.8552

Table 133. Mass of settled sediments in the trays for low velocity gradient control run duplicate C4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.05	399.25	6.20
2	787.00	802.00	15.00
3	790.75	800.95	10.20
4	787.25	806.00	18.75
5	787.10	807.85	20.75
6	787.30	809.00	21.70
7	393.65	411.40	17.75
8	792.80	814.80	22.00
9	789.50	809.00	19.50
10	788.65	806.35	17.70
11	1182.95	1203.50	20.55

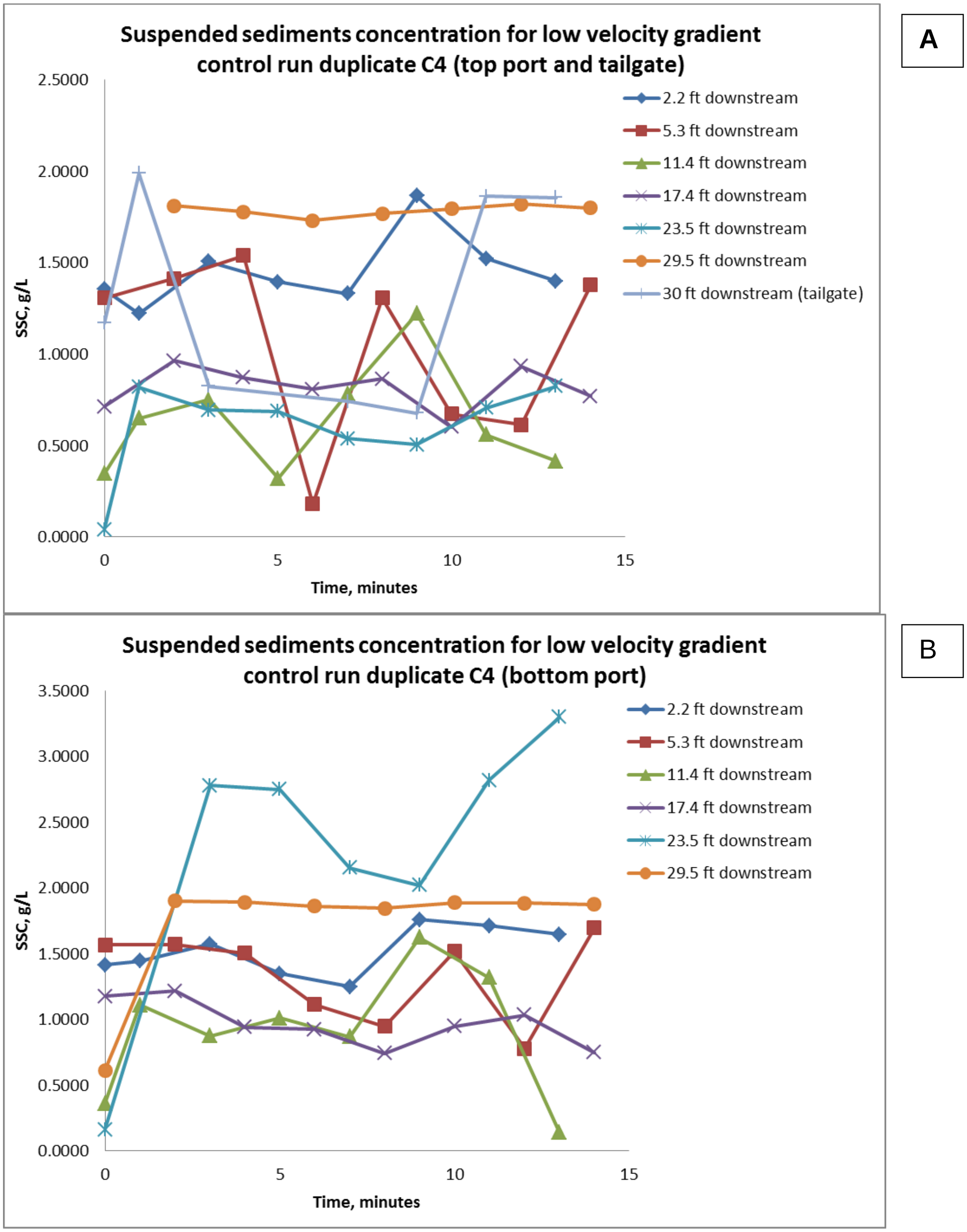


Figure 43. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

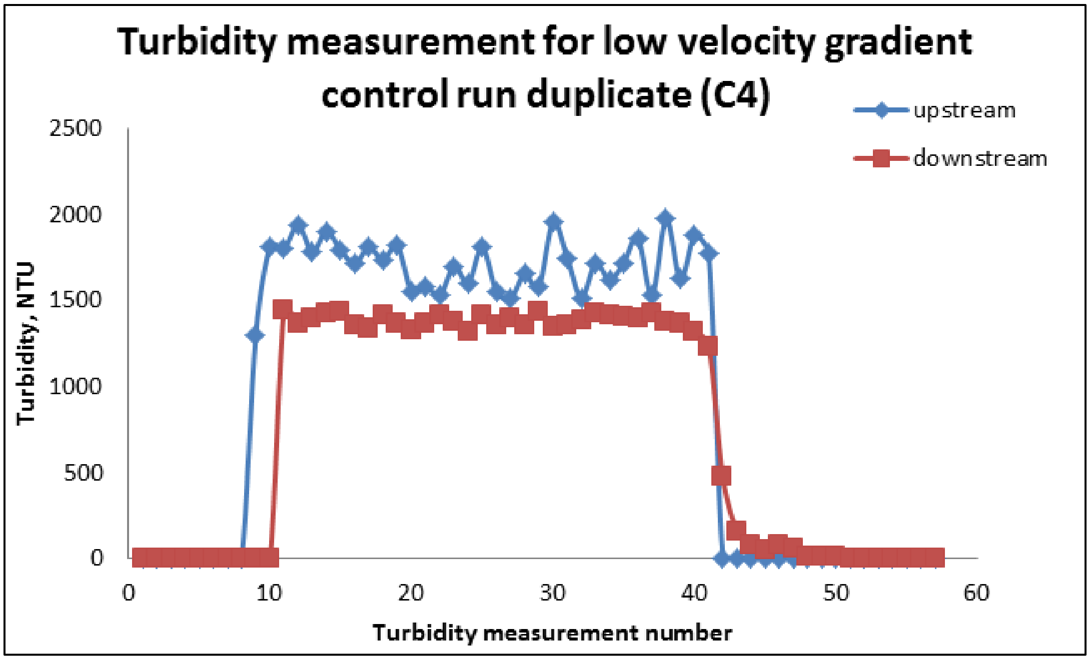


Figure 44. Upstream and downstream turbidity for low velocity gradient control run duplicate C4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port B High Velocity Gradient Control Run C5</u>

The speed of the oscillating grids was set at 148 rpm. Tables 134 to 141 show the measured data for this run, and Figure 45 shows the graph of the sediment concentration. The turbidity measurement for C5 did not get recorded correctly and therefore is not reported.

Table 134. Suspended sediment concentration for high velocity gradient control run C5 at Station 1('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3242	26.3562	26.7780	26.8246	0.4538	0.4684	1.8152	1.8736
2	26.4975	26.4511	26.9591	26.9255	0.4616	0.4744	1.8464	1.8976
3	26.3729	26.3010	26.7495	26.7271	0.3766	0.4261	1.5064	1.7044
4	26.2158	26.4209	26.6719	26.8913	0.4561	0.4704	1.8244	1.8816
5	26.2860	26.4824	26.7449	26.9976	0.4589	0.5152	1.8356	2.0608
6	26.2921	26.4673	26.7254	26.9040	0.4333	0.4367	1.7332	1.7468

Table 135. Suspended sediment concentration for high velocity gradient control run C5 at Station 2('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2856	26.4216	26.7385	26.8278	0.4529	0.4062	1.8116	1.6248
2	26.4205	26.3820	26.8382	26.7921	0.4177	0.4101	1.6708	1.6404
3	26.3625	26.4011	26.7518	26.8394	0.3893	0.4383	1.5572	1.7532
4	26.6105	26.5087	26.9803	26.8899	0.3698	0.3812	1.4792	1.5248
5	26.5428	26.6185	26.9348	26.9868	0.3920	0.3683	1.5680	1.4732
6	26.5890	26.5659	26.9228	26.9750	0.3338	0.4091	1.3352	1.6364

Table 136. Suspended sediment concentration for high velocity gradient control run C5 at Station 3('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3793	26.3783	26.7869	26.8450	0.0581	0.4667	0.2324	1.8668
2	26.6310	26.4940	26.8835	26.7684	0.2525	0.2744	1.0100	1.0976
3	26.4637	26.3000	26.8381	26.7301	0.3744	0.4301	1.4976	1.7204
4	26.6056	26.5897	26.9137	26.9551	0.3081	0.3654	1.2324	1.4616
5	26.4450	26.3469	26.7333	26.8126	0.2883	0.4657	1.1532	1.8628
6	26.5011	26.2458	26.9554	26.7030	0.4543	0.4572	1.8172	1.8288

Table 137. Suspended sediment concentration for high velocity gradient control run C5 at Station 4('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4558	26.2978	26.8687	26.7451	0.4129	0.4473	1.6516	1.7892
2	26.3936	26.3538	26.8761	26.8319	0.4825	0.4781	1.9300	1.9124
3	26.3913	26.4317	26.8690	26.8931	0.4777	0.4614	1.9108	1.8456
4	26.2762	26.4965	26.7484	26.9695	0.4722	0.4730	1.8888	1.8920
5	26.4234	26.4308	26.9122	26.8676	0.4888	0.4368	1.9552	1.7472
6	26.4041	26.3379	26.7315	26.7294	0.3274	0.3915	1.3096	1.5660

Table 138. Suspended sediment concentration for high velocity gradient control run C5 at Station 5('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2979	26.3045	26.9465	26.8884	0.6486	0.5839	2.5944	2.3356
2	26.3909	26.2775	26.9603	26.7587	0.5694	0.4812	2.2776	1.9248
3	26.5130	26.2900	26.9774	26.9995	0.4644	0.7095	1.8576	2.8380
4	26.2702	26.3911	26.9773	26.8507	0.7071	0.4596	2.8284	1.8384
5	26.2489	26.4493	27.0931	26.9378	0.8442	0.4885	3.3768	1.9540
6	26.2993	26.2791	27.1680	26.7461	0.8687	0.4670	3.4748	1.8680

Table 139. Suspended sediment concentration for high velocity gradient control run C5 at Station 6('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5147	26.3956	26.6131	26.6740	0.0984	0.2784	0.3936	1.1136
2	26.4314	26.6442	26.8443	26.9521	0.4129	0.3079	1.6516	1.2316
3	26.3962	26.4161	26.8118	26.8669	0.4156	0.4508	1.6624	1.8032
4	26.3250	26.2915	26.7491	26.7403	0.4241	0.4488	1.6964	1.7952
5	26.4212	26.3683	26.8506	26.7963	0.4294	0.4280	1.7176	1.7120
6	26.4549	26.8791	26.8552	26.8130	0.4003	-	1.6012	-

Table 140. Suspended sediment concentration for high velocity gradient control run C5 at tailgate('-' indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.2953	26.3750	0.0797	0.3188
2	26.2510	26.6351	0.3841	1.5364
3	26.5112	26.9192	0.4080	1.6320
4	26.3152	26.7430	0.4278	1.7112
5	26.4860	26.9207	0.4347	1.7388
6	26.5936	26.9325	0.3389	1.3556

Table 141. Mass of settled sediments in the trays for high velocity gradient control run C5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.75	438.90	5.15
2	829.90	843.05	13.15
3	793.10	811.70	18.60
4	786.50	807.35	20.85
5	786.35	802.50	16.15
6	788.25	808.40	20.15
7	393.55	410.70	17.15
8	790.45	808.30	17.85
9	786.70	815.35	28.65
10	1180.75	1198.00	17.25
11	1183.15	1202.20	19.05

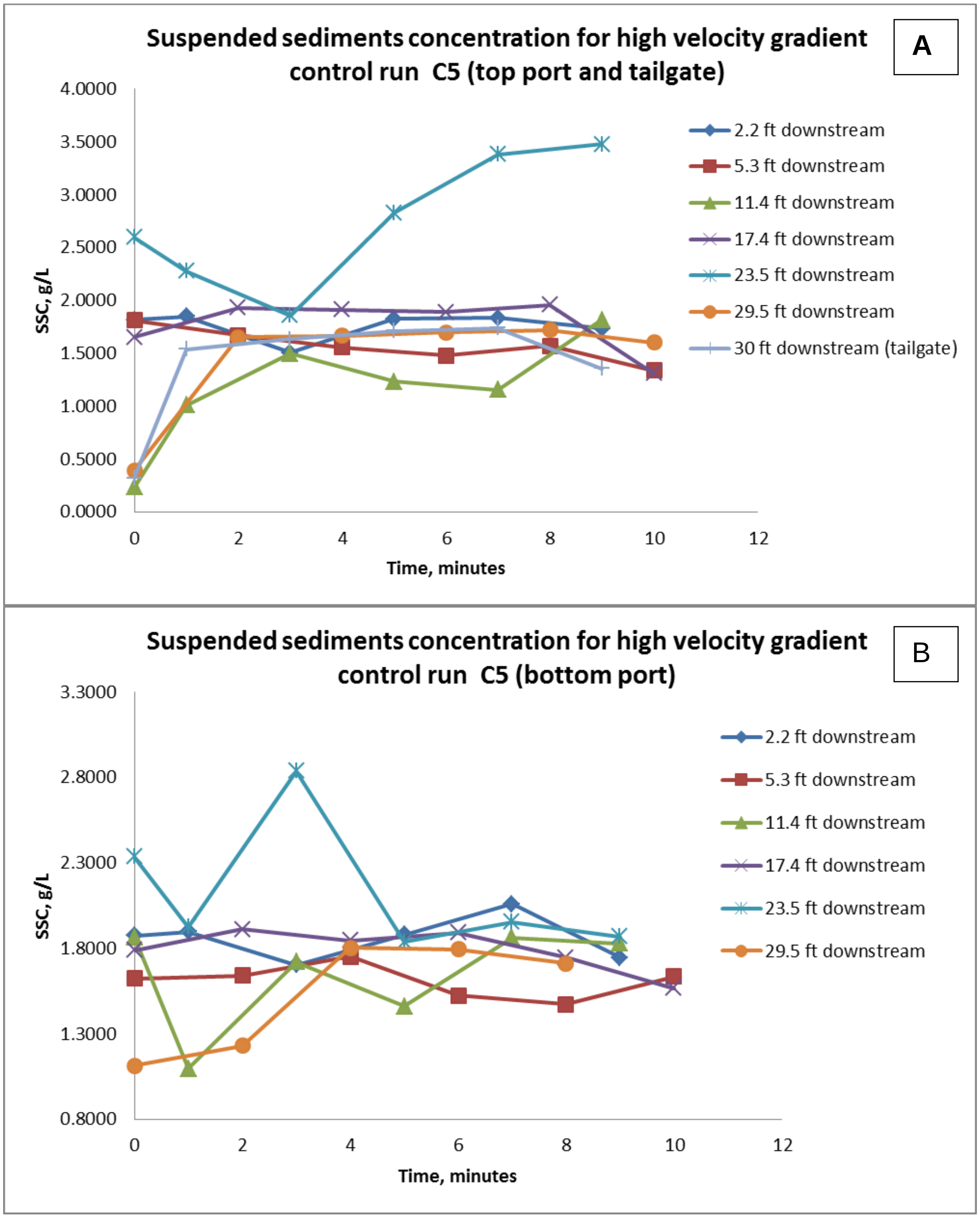


Figure 45. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

Port B High Velocity Gradient Control Run Duplicate (C6)

The oscillating grid speed was set at 148 rpm. Tables 142 and 149 show the data related to this run, and Figure 46 shows the graph of the sediment concentration. Figure 47 shows the graph of the upstream and downstream turbidity.

Table 142. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3834	31.3493	31.8898	31.8450	0.5064	0.4957	2.0256	1.9828
2	31.4528	31.3383	31.9373	31.8273	0.4845	0.4890	1.9380	1.9560
3	31.3667	31.4577	31.8700	31.9388	0.5033	0.4811	2.0132	1.9244
4	31.2312	31.3976	31.7303	31.9015	0.4991	0.5039	1.9964	2.0156
5	31.3710	31.2098	31.8591	31.6870	0.4881	0.4772	1.9524	1.9088
6	31.5013	31.3670	31.9661	31.8512	0.4648	0.4842	1.8592	1.9368

Table 143. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3953	31.4330	31.6161	31.9163	0.2208	0.4833	0.8832	1.9332
2	31.3509	31.1752	31.8265	31.9393	0.4756	0.7641	1.9024	3.0564
3	31.3759	31.4682	31.7863	31.9006	0.4104	0.4324	1.6416	1.7296
4	31.3661	31.3584	31.8387	31.8115	0.4726	0.4531	1.8904	1.8124
5	31.3673	31.4113	31.8974	31.8747	0.5301	0.4634	2.1204	1.8536
6	31.3996	31.2167	31.8470	31.8952	0.4474	0.6785	1.7896	2.7140

Table 144. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1136	31.4449	31.6161	31.9163	0.3002	0.4714	1.2008	1.8856
2	31.3463	31.4751	31.8265	31.9393	0.4802	0.4642	1.9208	1.8568
3	31.3638	31.4455	31.7863	31.9006	0.4225	0.4551	1.6900	1.8204
4	31.3784	31.3520	31.8387	31.8115	0.4603	0.4595	1.8412	1.8380
5	31.4480	31.4425	31.8974	31.8747	0.4494	0.4322	1.7976	1.7288
6	31.3890	31.4405	31.8470	31.8952	0.4580	0.4547	1.8320	1.8188

Table 145. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1950	31.4661	31.6992	31.8855	0.5042	0.4194	2.0168	1.6776
2	31.4648	31.3613	31.9400	31.8346	0.4752	0.4733	1.9008	1.8932
3	31.4467	31.4553	31.8655	31.9329	0.4188	0.4776	1.6752	1.9104
4	31.1528	31.4130	31.6411	31.8866	0.4883	0.4736	1.9532	1.8944
5	31.3398	31.3665	31.8223	31.8396	0.4825	0.4731	1.9300	1.8924
6	31.3553	31.3565	31.8381	31.8273	0.4828	0.4708	1.9312	1.8832

Table 146. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5416	31.3958	31.9606	31.8382	0.4190	0.4424	1.6760	1.7696
2	31.3624	31.3659	31.8150	31.8281	0.4526	0.4622	1.8104	1.8488
3	31.3739	31.4152	31.8247	31.8705	0.4508	0.4553	1.8032	1.8212
4	31.4056	31.5264	31.8565	31.9894	0.4509	0.4630	1.8036	1.8520
5	31.3686	31.4797	31.8186	31.9385	0.4500	0.4588	1.8000	1.8352
6	31.2285	31.4576	31.6776	31.9200	0.4491	0.4624	1.7964	1.8496

Table 147. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 6 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3867	31.3916	31.7554	31.8421	0.3687	0.4505	1.4748	1.8020
2	31.3624	31.4158	31.7932	31.8641	0.4308	0.4483	1.7232	1.7932
3	31.5287	31.4030	31.9579	31.8550	0.4292	0.4520	1.7168	1.8080
4	31.3843	31.3978	31.8203	31.8593	0.4360	0.4615	1.7440	1.8460
5	31.3682	31.3907	31.8015	31.8433	0.4333	0.4526	1.7332	1.8104
6	31.1459	31.3110	31.5808	31.7672	0.4349	0.4562	1.7396	1.8248

Table 148. Suspended sediment concentration for high velocity gradient control run duplicate C6 at tailgate ('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	31.2008	31.4698	0.2690	1.0760
2	31.4609	31.8931	0.4322	1.7288
3	31.4749	31.9096	0.4347	1.7388
4	31.5428	31.9796	0.4368	1.7472
5	31.4133	31.8389	0.4256	1.7024
6	31.5300	31.9411	0.4111	1.6444

Table 149. Mass of the sediment settled in the trays for high velocity gradient control run duplicate C6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	-	-	-
2	871.60	881.85	10.25
3	827.35	838.70	11.35
4	870.95	883.20	12.25
5	869.65	882.00	12.35
6	871.70	885.30	13.60
7	871.60	886.60	15.00
8	828.65	840.25	11.60
9	1182.70	1195.45	12.75
10	1182.60	1195.65	13.05
11	1222.45	1236.60	14.15

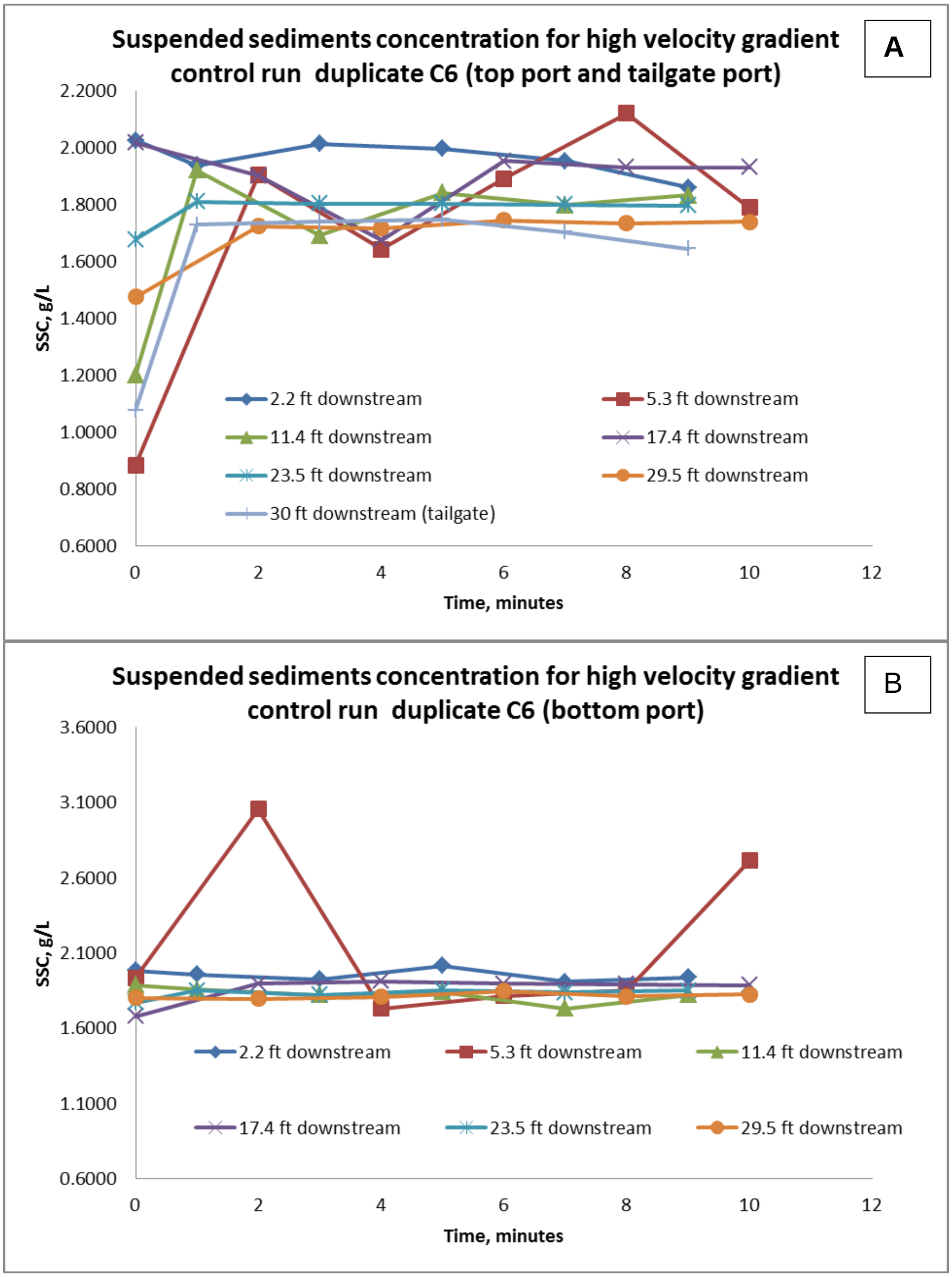


Figure 46. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

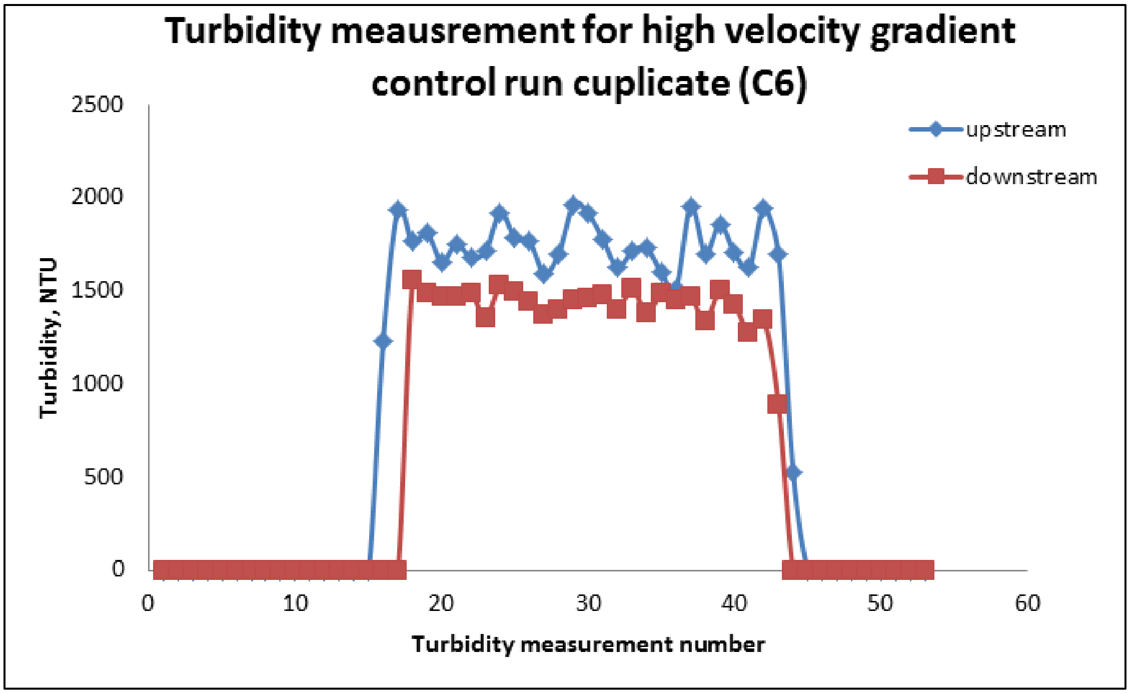


Figure 47. Upstream and downstream turbidity for high velocity gradient control run duplicate C6. The turbidity measurement number indicates every 30 second time interval **after which the turbidity reading was recorded by the instrument.**

Port B Low Velocity Gradient Flocculation Run (F1)

The oscillating grid speed was set at 99 rpm. Tables 150 to 157 show the data related to this run, and Figure 49 shows the graph of the sediment concentration. Figure 48 shows the graph of the upstream and downstream turbidity.

Table 150. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3910	26.4334	26.9431	26.9915	0.5521	0.5581	2.2084	2.2324
2	26.4043	26.4057	26.9464	26.9437	0.5421	0.5380	2.1684	2.1520
3	26.5317	26.5847	27.0436	27.1068	0.5119	0.5221	2.0476	2.0884
4	26.3599	26.3758	26.8874	26.9135	0.5275	0.5377	2.1100	2.1508
5	26.4319	26.5039	26.9262	27.0171	0.4943	0.5132	1.9772	2.0528
6	26.5201	26.3550	27.0517	26.8761	0.5316	0.5211	2.1264	2.0844
7	26.3796	26.5019	26.9161	27.0312	0.5365	0.5293	2.1460	2.1172
8	26.4096	26.3991	26.9281	26.9156	0.5185	0.5165	2.0740	2.0660

Table 151. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4060	26.4114	26.9279	26.9574	0.5219	0.5460	2.0876	2.1840
2	26.4900	26.5887	27.0293	27.1332	0.5393	0.5445	2.1572	2.1780
3	26.3927	26.3670	26.9148	26.8991	0.5221	0.5321	2.0884	2.1284
4	26.3460	26.3970	26.8790	26.9332	0.5330	0.5362	2.1320	2.1448
5	26.4191	26.5030	26.9242	27.0329	0.5051	0.5299	2.0204	2.1196
6	26.3765	26.5638	26.8943	27.0996	0.5178	0.5358	2.0712	2.1432
7	26.4258	26.4907	26.9327	27.0067	0.5069	0.5160	2.0276	2.0640
8	26.5986	26.4172	27.1079	26.9413	0.5093	0.5241	2.0372	2.0964

Table 152. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 3 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3379	26.5521	26.8644	27.0878	0.5265	0.5357	2.1060	2.1428
2	26.3854	26.4900	26.5863	27.0347	0.2009	0.5447	0.8036	2.1788
3	26.5731	26.5420	26.7656	27.0804	0.1925	0.5384	0.7700	2.1536
4	26.4460	26.4874	26.6484	27.0281	0.2024	0.5407	0.8096	2.1628
5	26.3595	26.5099	26.5786	27.1957	0.2191	0.6858	0.8764	2.7432
6	26.3838	26.3800	26.6051	27.5498	0.2213	1.1698	0.8852	4.6792
7	26.3720	26.3855	26.6156	27.7161	0.2436	1.3306	0.9744	5.3224
8	26.4493	26.5401	26.7081	28.2214	0.2588	1.6813	1.0352	6.7252

Table 153. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 4 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4927	26.5753	26.8862	26.9701	0.3935	0.3948	1.5740	1.5792
2	26.3933	26.6098	26.5492	26.9365	0.1559	0.3267	0.6236	1.3068
3	26.6045	26.3439	26.7601	26.6659	0.1556	0.3220	0.6224	1.2880
4	26.5104	26.3904	26.6575	26.6954	0.1471	0.3050	0.5884	1.2200
5	26.3595	26.3877	26.5090	26.6912	0.1495	0.3035	0.5980	1.2140
6	26.4343	26.5707	26.5497	26.8266	0.1154	0.2559	0.4616	1.0236
7	26.4543	26.4376	26.6113	26.7542	0.1570	0.3166	0.6280	1.2664
8	26.2756	26.5115	26.4380	26.8370	0.1624	0.3255	0.6496	1.3020

Table 154. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 5 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4073	26.5003	26.6620	26.8721	0.2547	0.3718	1.0188	4.0752
2	26.4576	26.5041	26.8333	27.0339	0.3757	0.5298	1.5028	6.0112
3	26.4252	26.4042	26.6014	26.7136	0.1762	0.3094	0.7048	2.8192
4	26.6022	26.5255	26.7671	26.8043	0.1649	0.2788	0.6596	2.6384
5	26.3869	26.5220	26.5547	26.7982	0.1678	0.2762	0.6712	2.6848
6	26.4617	26.4562	26.6264	26.7363	0.1647	0.2801	0.6588	2.6352
7	26.4815	26.5337	26.6490	26.8286	0.1675	0.2949	0.6700	2.6800
8	26.3655	26.5219	26.5354	26.8072	0.1699	0.2853	0.6796	2.7184

Table 155. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 6 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3674	26.4951	26.6022	26.5605	0.2348	0.0654	0.9392	0.2616
2	26.3648	26.4203	26.5560	26.8258	0.1912	0.4055	0.7648	1.6220
3	26.5615	26.6023	26.7202	26.8613	0.1587	0.2590	0.6348	1.0360
4	26.3921	26.3494	26.5383	26.5981	0.1462	0.2487	0.5848	0.9948
5	26.3834	26.3960	26.5309	26.6352	0.1475	0.2392	0.5900	0.9568
6	26.5269	26.5259	26.6733	26.7839	0.1464	0.2580	0.5856	1.0320
7	26.4657	26.4973	26.6182	26.7545	0.1525	0.2572	0.6100	1.0288
8	26.4530	26.4592	26.5648	26.7232	0.1118	0.2640	0.4472	1.0560

Table 156. Suspended sediment concentration for low velocity gradient flocculation run F1 at tailgate ('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.4620	26.6687	0.2067	0.8268
2	26.4527	26.7711	0.3184	1.2736
3	26.4451	26.6202	0.1751	0.7004
4	26.5810	26.7771	0.1961	0.7844
5	26.5170	26.6816	0.1646	0.6584
6	26.4365	26.6064	0.1699	0.6796
7	26.3689	26.5477	0.1788	0.7152
8	26.5468	26.7150	0.1682	0.6728

Table 157. Mass of the sediment settled in the trays for low velocity gradient flocculation run F1.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.45	769.60	9.15
2	1520.30	-	-
3	1521.10	1893.35	372.25
4	2281.80	3181.95	900.15
5	2280.10	3062.55	782.45
6	1521.80	1860.35	338.55
7	1520.40	1705.50	185.10
8	761.30	885.55	124.25
9	1520.10	1612.20	92.10
10	1520.90	1590.95	70.05
11	761.80	820.55	58.75

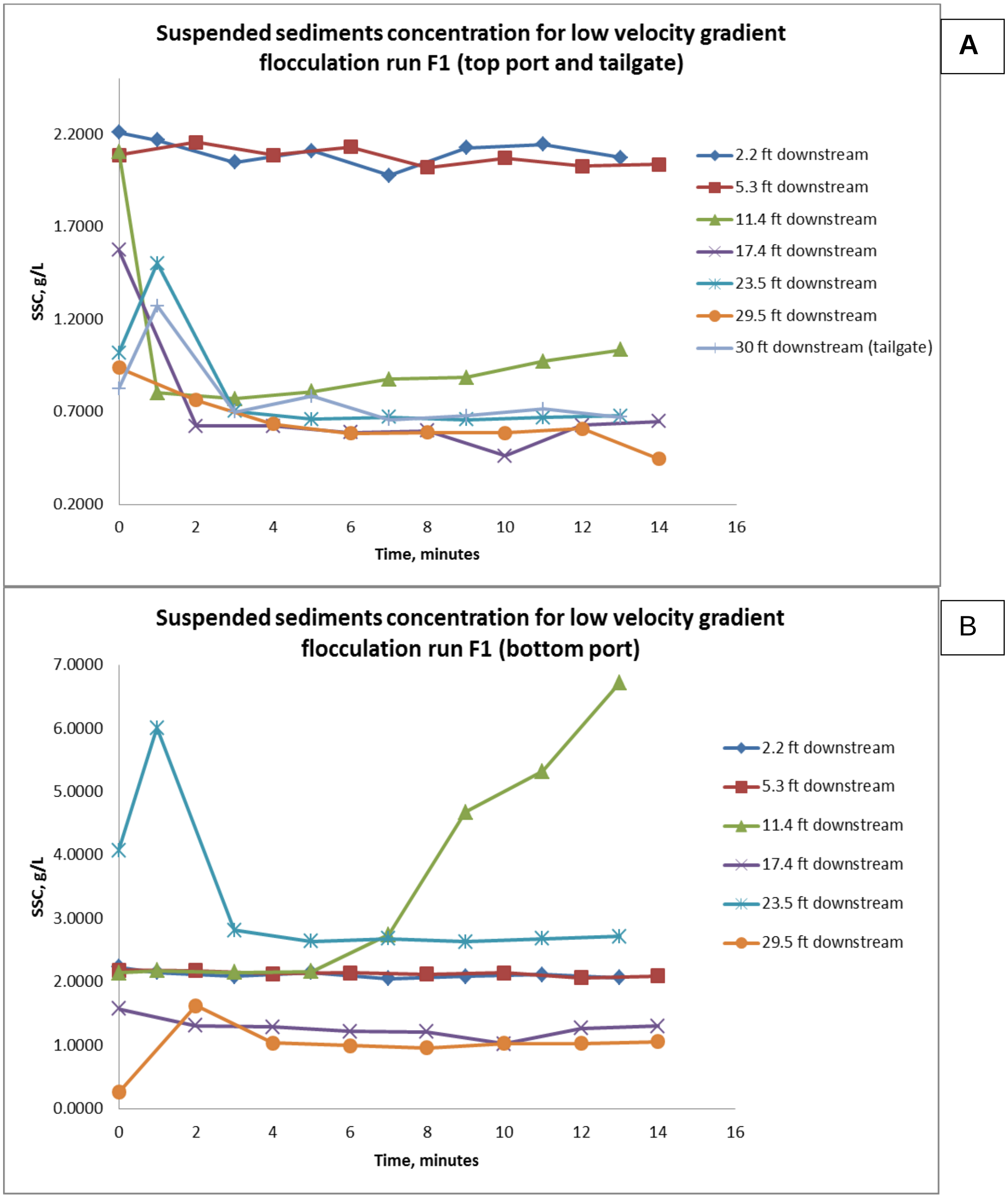


Figure 48. **Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.**

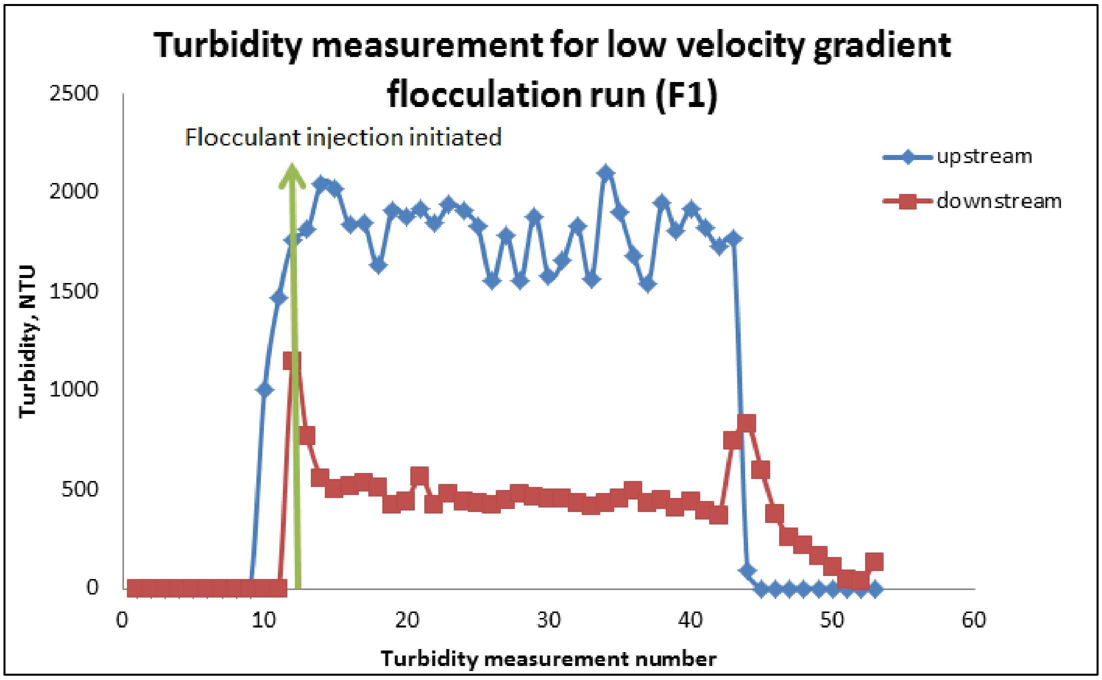


Figure 49. Upstream and downstream turbidity for low velocity gradient flocculation run F1. The turbidity measurement number indicates every 30 second time interval **after which the turbidity reading was recorded by the instrument.**

Port B High Velocity Gradient Flocculation Run (F2)

The oscillating grid speed was set at 148 rpm. Tables 158 to 165 show the data related to this run, and Figure 50 shows the graph of the sediment concentration. Figure 51 shows the graph of the upstream and downstream turbidity.

Table 158. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	26.5030	26.4201	27.0180	26.9260	0.5150	0.5059	2.0600	2.0236
2	26.5985	26.4592	27.0575	26.8821	0.4590	0.4229	1.8360	1.6916
3	26.5660	26.4688	27.0111	26.8554	0.4451	0.3866	1.7804	1.5464
4	26.4166	26.4901	26.8902	26.9496	0.4736	0.4595	1.8944	1.8380
5	26.5573	26.6466	26.8915	27.0978	0.3342	0.4512	1.3368	1.8048
6	26.6614	26.5780	27.0887	27.0075	0.4273	0.4295	1.7092	1.7180
7	26.4476	26.3806	26.9178	26.9213	0.4702	0.5407	1.8808	2.1628
8	26.5353	26.6027	26.9917	27.0068	0.4564	0.4041	1.8256	1.6164

Table 159. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	26.5912	26.7430	27.0544	27.1358	0.4632	0.3928	1.8528	1.5712
2	26.5065	26.6122	27.0262	27.0821	0.5197	0.4699	2.0788	1.8796
3	26.5925	26.5380	26.9417	26.9419	0.3492	0.4039	1.3968	1.6156
4	26.4744	26.5273	26.9070	26.9535	0.4326	0.4262	1.7304	1.7048
5	26.5143	26.6643	26.9877	27.1838	0.4734	0.5195	1.8936	2.0780
6	26.5163	26.6701	26.9000	27.0349	0.3837	0.3648	1.5348	1.4592
7	26.6039	26.5984	27.0280	27.0232	0.4241	0.4248	1.6964	1.6992
8	26.4388	26.5547	26.9348	27.0682	0.4960	0.5135	1.9840	2.0540

Table 160. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3727	26.4036	26.8898	26.8533	0.5171	0.4497	2.0684	1.7988
2	26.5243	26.4692	26.5929	26.9183	0.0686	0.4491	0.2744	1.7964
3	26.6691	26.6830	26.8197	27.1088	0.1506	0.4258	0.6024	1.7032
4	26.4315	26.5094	26.7182	26.9686	0.2867	0.4592	1.1468	1.8368
5	26.6355	26.4748	26.8217	26.9530	0.1862	0.4782	0.7448	1.9128
6	26.4759	26.6726	26.6680	27.3986	0.1921	0.7260	0.7684	2.9040
7	26.6039	26.4874	26.8617	27.2669	0.2578	0.7795	1.0312	3.1180
8	26.5893	26.4376	26.8478	27.3406	0.2585	0.9030	1.0340	3.6120

Table 161. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5880	26.4730	26.9954	26.8612	0.4074	0.3882	1.6296	1.5528
2	26.5931	26.5316	26.6719	26.7430	0.0788	0.2114	0.3152	0.8456
3	26.6166	26.4502	26.7344	26.6600	0.1178	0.2098	0.4712	0.8392
4	26.6443	26.6806	26.7647	26.8615	0.1204	0.1809	0.4816	0.7236
5	26.4327	26.5770	26.5722	26.7718	0.1395	0.1948	0.5580	0.7792
6	26.5549	26.5335	26.6703	26.7225	0.1154	0.1890	0.4616	0.7560
7	26.5558	26.4834	26.5284	26.7274	-0.0274	0.2440	-	0.9760
8	26.4293	26.4826	26.5579	26.6493	0.1286	0.1667	0.5144	0.6668

Table 162. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.7228	26.5865	27.0479	26.9603	0.3251	0.3738	1.3004	5.2016
2	26.4354	26.5045	26.7238	26.8847	0.2884	0.3802	1.1536	4.6144
3	26.4620	26.4572	26.4948	26.5928	0.0328	0.1356	0.1312	0.5248
4	26.5428	26.6251	26.6168	26.6963	0.0740	0.0712	0.2960	1.1840
5	26.4655	26.6525	26.6299	26.8360	0.1644	0.1835	0.6576	2.6304
6	26.4729	26.5418	26.5837	26.6556	0.1108	0.1138	0.4432	1.7728
7	26.5756	26.5677	26.6790	26.7158	0.1034	0.1481	0.4136	1.6544
8	26.4322	26.5160	-	26.7185	-	0.2025	-	0.8100

Table 163. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 6('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4706	26.4723	26.7031	26.8819	0.2325	0.4096	0.9300	1.6384
2	26.6205	26.3779	26.7311	26.7180	0.1106	0.3401	0.4424	1.3604
3	26.5325	26.4100	26.5757	26.5601	0.0432	0.1501	0.1728	0.6004
4	26.4634	26.6693	26.5093	27.7015	0.0459	1.0322	0.1836	4.1288
5	26.4998	26.4378	26.6601	26.5779	0.1603	0.1401	0.6412	0.5604
6	26.5358	26.4816	26.6431	26.5847	0.1073	0.1031	0.4292	0.4124
7	26.5996	26.5796	26.6978	26.7137	0.0982	0.1341	0.3928	0.5364
8	26.5246	26.5345	26.6640	26.7250	0.1394	0.1905	0.5576	0.7620

Table 164. Suspended sediment concentration for high velocity gradient flocculation run F2 at tailgate(‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.6150	26.7076	0.0926	0.3704
2	26.6220	26.9800	0.3580	1.4320
3	26.4768	26.5245	0.0477	0.1908
4	26.5646	26.5220	-	-
5	26.6965	26.7075	0.0110	0.0440
6	26.5173	26.6263	0.1090	0.4360
7	26.6541	26.7902	0.1361	0.5444
8	26.5923	26.7240	0.1317	0.5268

Table 165. Mass of the sediment settled in the trays for high velocity gradient flocculation run F2

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.20	770.60	10.40
2	760.95	884.20	123.25
3	1519.80	1958.15	438.35
4	2280.10	3082.65	802.55
5	2280.90	3011.75	730.85
6	1519.80	1946.70	426.90
7	1520.70	1801.60	280.90
8	1521.35	1688.85	167.50
9	1520.85	1623.35	102.50
10	1520.45	1594.70	74.25
11	1520.45	1581.35	60.90

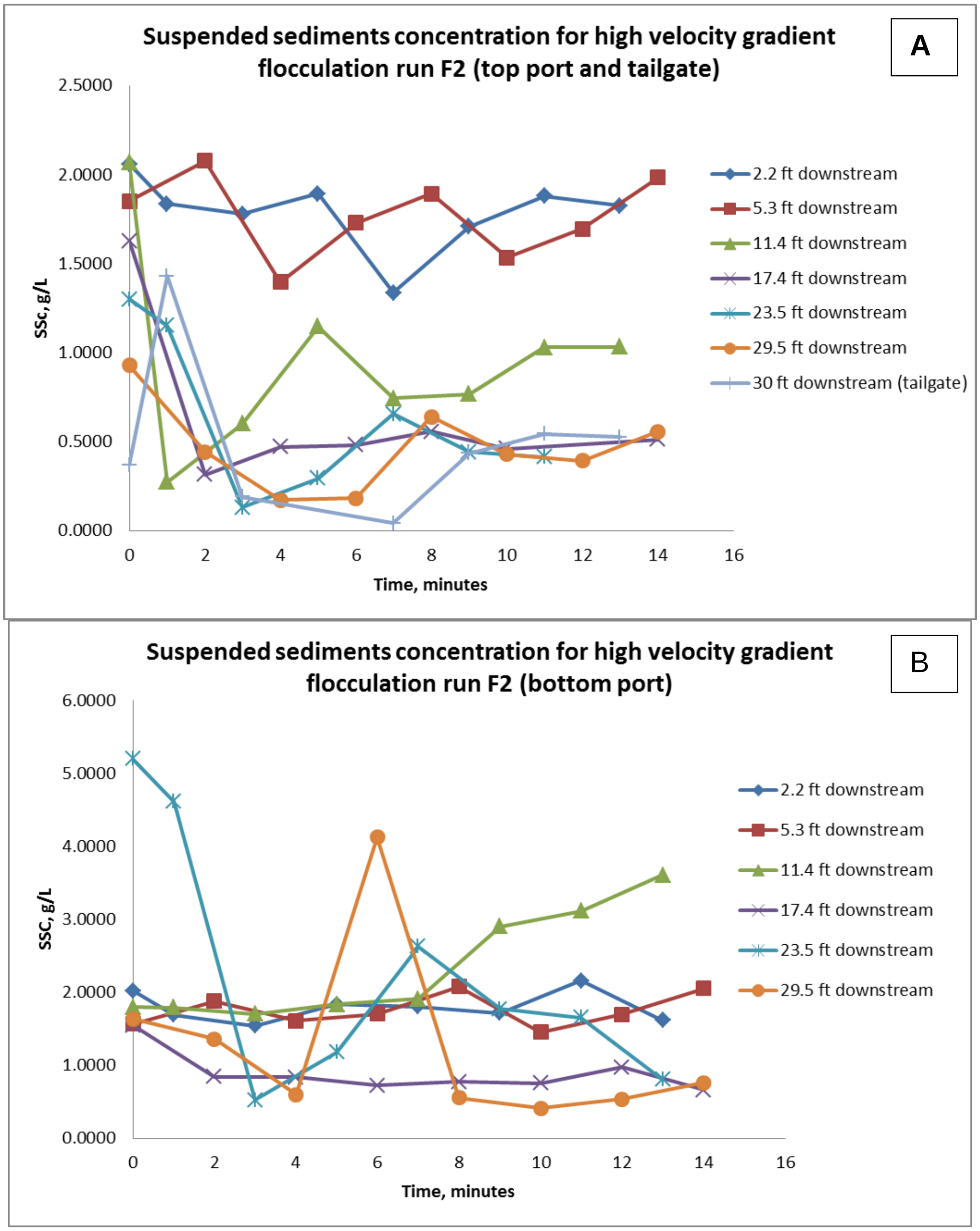


Figure 50. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

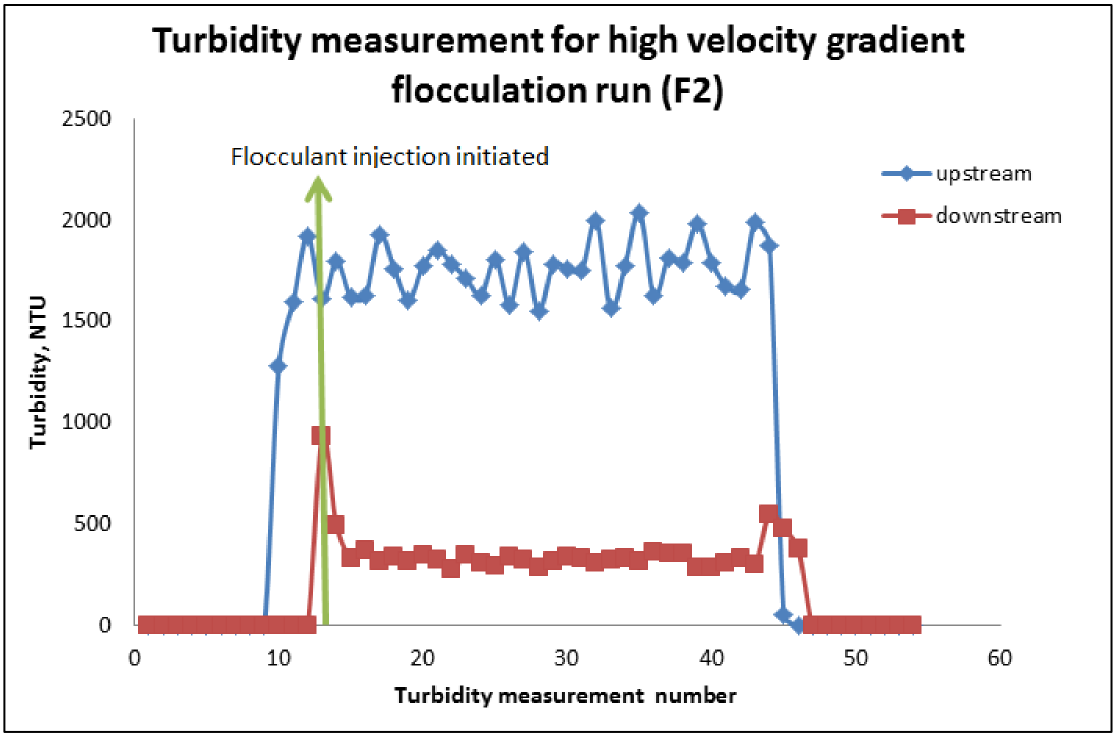


Figure 51. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port B Low Velocity Gradient Flocculation Run Duplicate (F3)</u>

The oscillating grid speed was set at 99 rpm. Tables 166 to 173 show the data related to this run, and Figure 52 shows the graph of the sediment concentration. Figure 53 shows the graph of the upstream and downstream turbidity.

Table 166. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	31.3883	31.3479	31.8296	31.8165	0.4413	0.4686	1.7652	1.8744
2	31.4579	31.3491	31.9226	31.8350	0.4647	0.4859	1.8588	1.9436
3	31.3737	31.4601	31.8519	31.9338	0.4782	0.4737	1.9128	1.8948
4	31.2425	31.4062	31.7036	31.8737	0.4611	0.4675	1.8444	1.8700
5	31.3775	31.2146	31.8528	31.7103	0.4753	0.4957	1.9012	1.9828
6	31.4871	31.3740	31.9605	31.8562	0.4734	0.4822	1.8936	1.9288

Table 167. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	31.4027	31.4393	31.8853	31.9058	0.4826	0.4665	1.9304	1.8660
2	31.3626	31.1819	31.8245	31.6615	0.4619	0.4796	1.8476	1.9184
3	31.3855	31.4772	31.8403	31.9272	0.4548	0.4500	1.8192	1.8000
4	31.3762	31.3688	31.8498	31.8462	0.4736	0.4774	1.8944	1.9096
5	31.3763	31.4036	31.8431	31.8731	0.4668	0.4695	1.8672	1.8780
6	31.4055	31.2225	31.8628	31.6995	0.4573	0.4770	1.8292	1.9080

Table 168. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1453	31.4506	31.5261	31.9324	0.3808	0.4818	1.5232	1.9272
2	31.3515	31.4819	31.5636	31.9640	0.2121	0.4821	0.8484	1.9284
3	31.3412	31.4518	31.5452	31.9153	0.2040	0.4635	0.8160	1.8540
4	31.3723	31.3590	31.6050	31.8427	0.2327	0.4837	0.9308	1.9348
5	31.4514	31.4426	31.6754	32.0369	0.2240	0.5943	0.8960	2.3772
6	31.3959	31.4546	31.6278	32.3752	0.2319	0.9206	0.9276	3.6824

Table 169. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2030	31.4087	31.6872	31.8717	0.4842	0.4630	1.9368	1.8520
2	31.4707	31.3666	31.6366	31.6487	0.1659	0.2821	0.6636	1.1284
3	31.3841	31.4613	31.5443	31.7290	0.1602	0.2677	0.6408	1.0708
4	31.1580	31.4147	31.3210	31.7053	0.1630	0.2906	0.6520	1.1624
5	31.3447	31.3714	31.5056	31.6454	0.1609	0.2740	0.6436	1.0960
6	31.3610	31.3594	31.5203	31.6349	0.1593	0.2755	0.6372	1.1020

Table 170. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 5(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5400	31.4022	31.9785	31.8551	0.4385	0.4529	1.7540	7.0160
2	31.3679	31.3711	31.6592	31.8470	0.2913	0.4759	1.1652	4.6608
3	31.3757	31.4130	31.5319	31.6453	0.1562	0.2323	0.6248	2.4992
4	31.4065	31.5330	31.5654	31.7674	0.1589	0.2344	0.6356	2.5424
5	31.3697	31.4748	31.5238	31.7045	0.1541	0.2297	0.6164	2.4656
6	31.2311	31.4600	31.3808	31.7006	0.1497	0.2406	0.5988	2.3952

Table 171. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 6(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3746	31.3972	31.6514	31.8000	0.2768	0.4028	1.1072	1.6112
2	31.3614	31.4219	31.5120	31.7889	0.1506	0.3670	0.6024	1.4680
3	31.5296	31.4048	31.6538	31.5985	0.1242	0.1937	0.4968	0.7748
4	31.3818	31.4015	31.5130	31.5938	0.1312	0.1923	0.5248	0.7692
5	31.3630	31.3841	31.4968	31.5700	0.1338	0.1859	0.5352	0.7436
6	31.1448	31.3102	31.2766	31.5105	0.1318	0.2003	0.5272	0.8012

Table 172. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment conc g/L
1	31.2023	31.4770	0.2747	1.0988
2	31.4646	31.8985	0.4339	1.7356
3	31.4746	31.6554	0.1808	0.7232
4	31.5392	31.7074	0.1682	0.6728
5	31.4137	31.5886	0.1749	0.6996
6	31.5239	31.6895	0.1656	0.6624

Table 173. Mass of the sediment settled in the trays for low velocity gradient flocculation run duplicate F3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.30	402.05	5.75
2	760.80	813.40	52.60
3	1521.30	1726.25	204.95
4	2281.55	2812.45	530.90
5	2281.35	2792.45	511.10
6	1522.25	1904.55	382.30
7	759.85	913.00	153.15
8	760.20	854.40	94.20
9	760.60	829.35	68.75
10	1521.45	1575.55	54.10
11	1521.85	1568.05	46.20

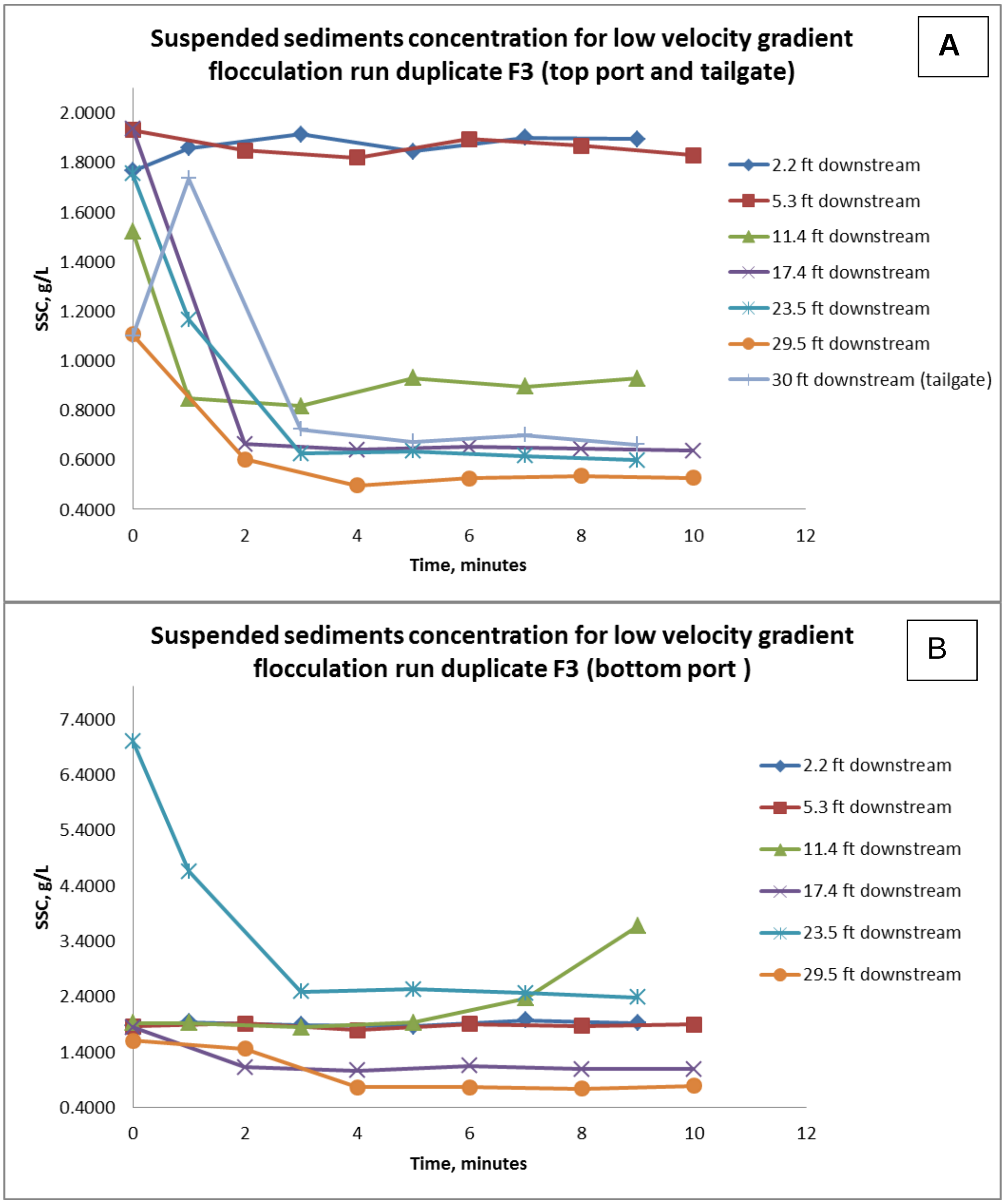


Figure 52. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

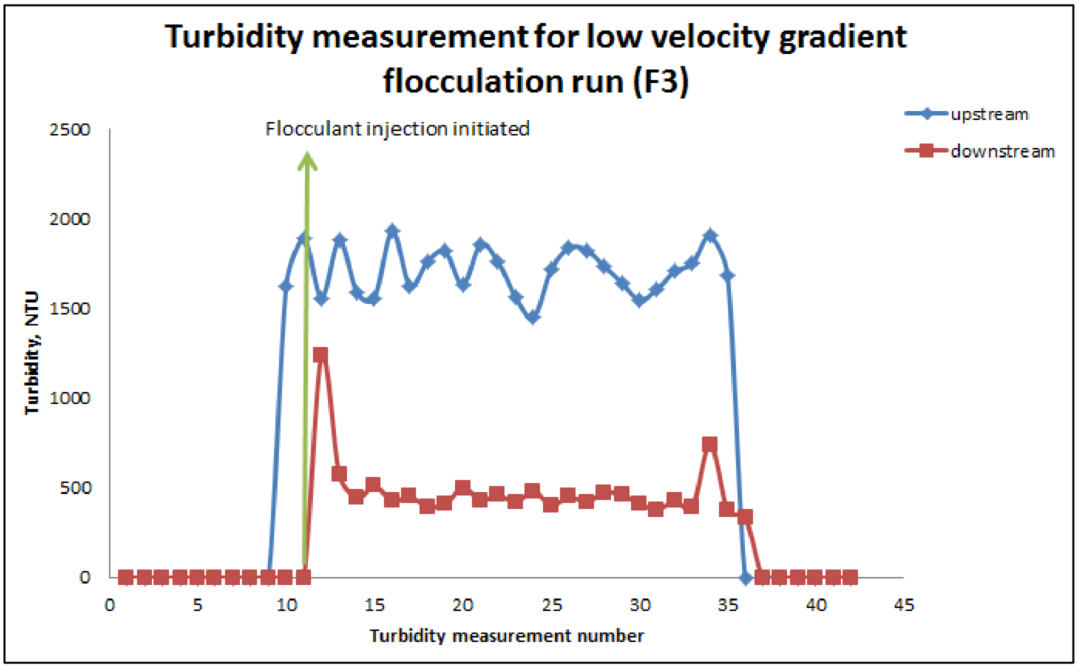


Figure 53. Upstream and downstream turbidity for low velocity gradient flocculation run duplicate F3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>High Velocity Gradient Flocculation Run Duplicate (F4)</u>

The oscillating grid speed was set at 148 rpm. Tables 174 to 181 show the data related to this run, and Figure 54 shows the graph of the sediment concentration. Figure 55 shows the graph of the upstream and downstream turbidity.

Table 174. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 1('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2063	31.4686	31.7145	31.9545	0.5082	0.4859	2.0328	1.9436
2	31.4279	31.4134	31.9452	31.8599	0.5173	0.4465	2.0692	1.7860
3	31.4387	31.3808	31.9094	31.8632	0.4707	0.4824	1.8828	1.9296
4	31.3659	31.4018	31.8321	31.8749	0.4662	0.4731	1.8648	1.8924
5	31.3888	31.4254	31.8975	31.8564	0.5087	0.4310	2.0348	1.7240
6	31.4436	31.3292	31.9258	31.8128	0.4822	0.4836	1.9288	1.9344

Table 175. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 2('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5422	31.4572	31.9462	31.9917	0.4040	0.5345	1.6160	2.1380
2	31.4603	31.4833	31.9253	31.9609	0.4650	0.4776	1.8600	1.9104
3	31.5333	31.2348	31.9859	31.7024	0.4526	0.4676	1.8104	1.8704
4	31.4930	31.4082	31.9211	31.8857	0.4281	0.4775	1.7124	1.9100
5	31.3509	31.3242	31.8202	31.7942	0.4693	0.4700	1.8772	1.8800
6	31.1419	31.3802	31.6080	31.8489	0.4661	0.4687	1.8644	1.8748

Table 176. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 3('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3913	31.4040	31.7084	31.8978	0.1894	0.4938	0.7576	1.9752
2	31.3591	31.4759	31.6194	31.9495	0.2603	0.4736	1.0412	1.8944
3	31.3687	31.2274	31.6680	31.6463	0.2993	0.4189	1.1972	1.6756
4	31.4595	31.2003	31.7209	31.6038	0.2614	0.4035	1.0456	1.6140
5	31.3716	31.4802	31.6250	31.8983	0.2534	0.4181	1.0136	1.6724
6	31.2085	31.4023	31.4739	31.8342	0.2654	0.4319	1.0616	1.7276

Table 177. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 4('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3699	31.4385	31.8215	31.8775	0.4516	0.4390	1.8064	1.7560
2	31.3863	31.3617	31.6206	31.6766	0.2343	0.3149	0.9372	1.2596
3	31.4270	31.4228	31.6531	31.7210	0.2261	0.2982	0.9044	1.1928
4	31.1364	31.4730	31.3537	31.7565	0.2173	0.2835	0.8692	1.1340
5	31.3766	31.4480	31.5762	31.7348	0.1996	0.2868	0.7984	1.1472
6	31.3311	31.5462	31.5255	31.8228	0.1944	0.2766	0.7776	1.1064

Table 178. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 5('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3350	31.4309	31.6703	31.8475	0.3353	0.4166	1.3412	5.3648
2	31.3704	31.1374	31.5761	31.5444	0.2057	0.4070	0.8228	3.2912
3	31.4636	31.4620	31.6476	31.6967	0.1840	0.2347	0.7360	2.9440
4	31.4877	31.3602	31.6597	31.6002	0.1720	0.2400	0.6880	2.7520
5	31.3803	31.2020	31.5549	31.4146	0.1746	0.2126	0.6984	2.7936
6	31.4521	31.2311	31.6225	31.4542	0.1704	0.2231	0.6816	2.7264

Table 179. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 6('-'indicates no data available).

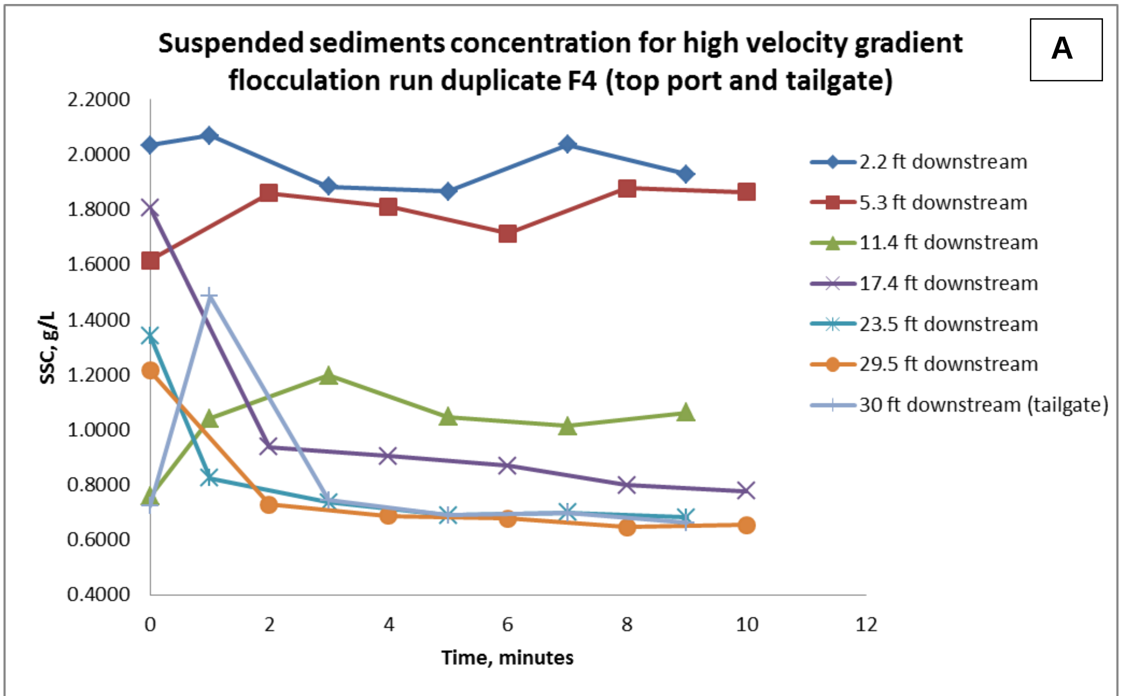
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4732	31.3895	31.7768	31.7713	0.3036	0.3818	1.2144	1.5272
2	31.4454	31.3855	31.6272	31.6707	0.1818	0.2852	0.7272	1.1408
3	31.5194	31.4212	31.6913	31.6256	0.1719	0.2044	0.6876	0.8176
4	31.3935	31.4730	31.5627	31.6718	0.1692	0.1988	0.6768	0.7952
5	31.4934	31.3572	31.6551	31.5522	0.1617	0.1950	0.6468	0.7800
6	31.2268	31.1501	31.3901	31.3472	0.1633	0.1971	0.6532	0.7884

Table 180. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at tailgate('-'indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	sediment concentration g/L
1	31.4460	31.6265	0.1805	0.7220
2	31.3628	31.7341	0.3713	1.4852
3	31.4840	31.6700	0.1860	0.7440
4	31.4326	31.6049	0.1723	0.6892
5	31.2610	31.4352	0.1742	0.6968
6	31.3985	31.5640	0.1655	0.6620

Table 181. Mass of the sediment settled in the trays for high velocity gradient flocculation run duplicate F4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	760.05	766.15	6.10
2	760.00	827.90	67.90
3	1520.15	1761.95	241.80
4	2280.50	2765.10	484.60
5	2279.75	2788.15	508.40
6	1520.55	1901.95	381.40
7	1520.40	1727.65	207.25
8	760.40	885.60	125.20
9	1520.30	1610.80	90.50
10	1520.40	1584.80	64.40
11	1521.35	1575.45	54.10



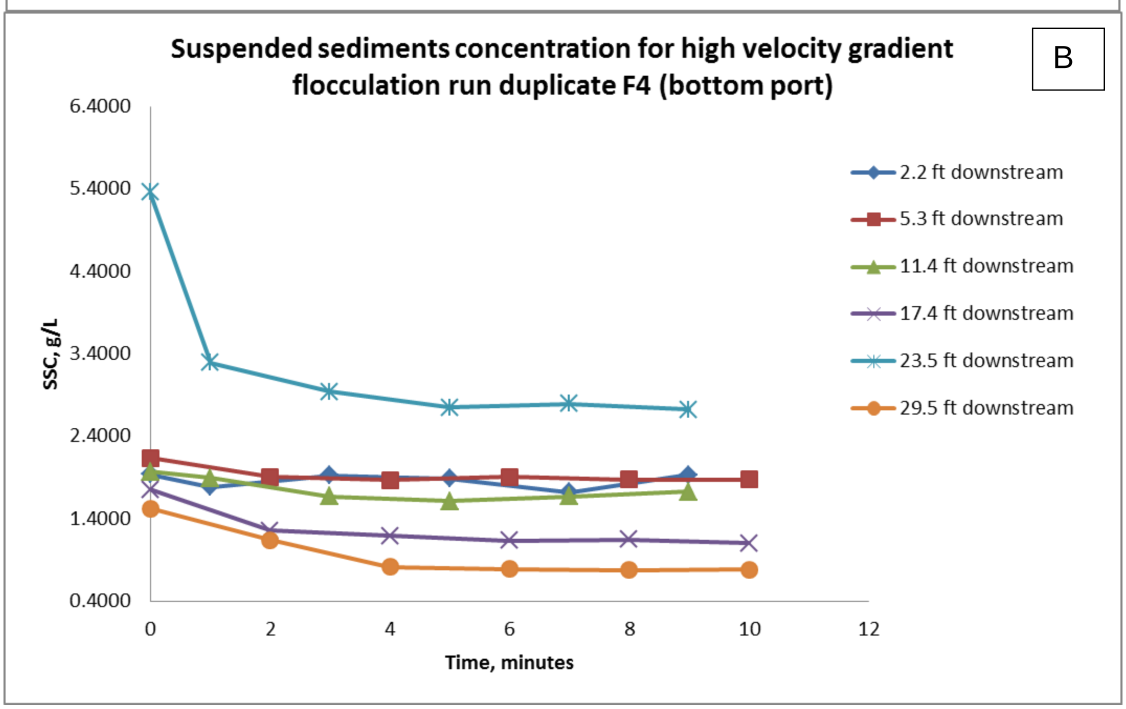


Figure 54: **Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.**

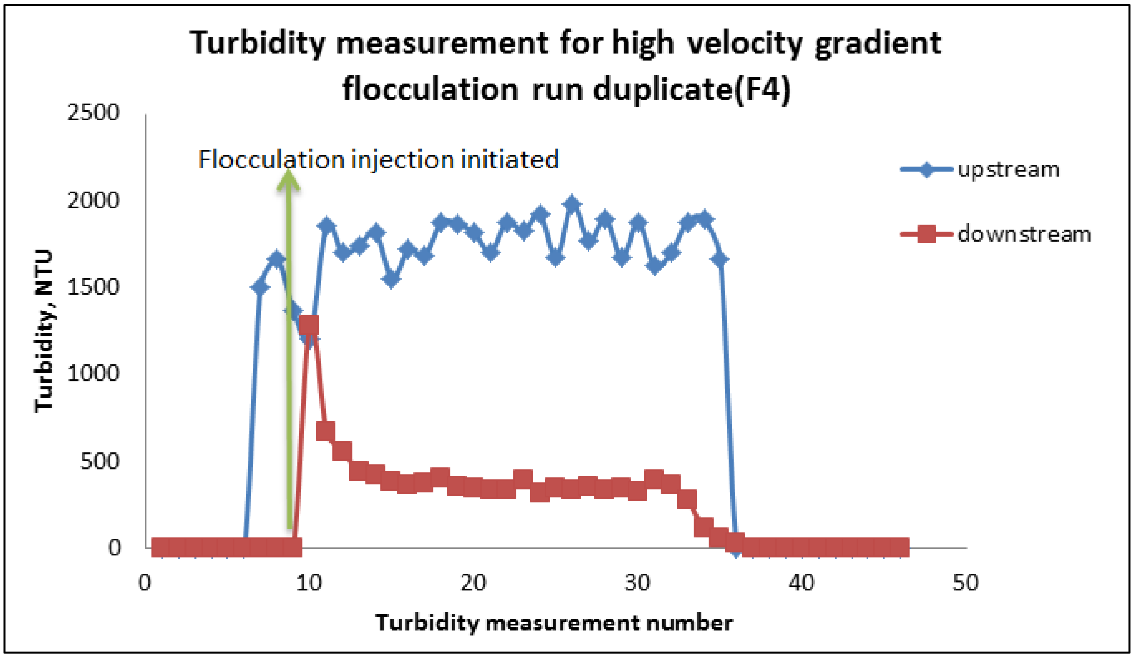


Figure 55. Upstream and downstream turbidity for high velocity gradient flocculation run duplicate F4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

Port B Low Velocity Gradient Flocculation Run Triplicate (F5)

The oscillating grid speed was set at 99 rpm. Tables 182 to 189 show the data related to this run, and Figure 56 shows the graph of the sediment concentration. Figure 57 shows the graph of the upstream and downstream turbidity.

Table 182: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4529	31.3748	31.9511	31.8766	0.4982	0.5018	1.9928	2.0072
2	31.4225	31.2564	31.8985	31.7153	0.4760	0.4589	1.9040	1.8356
3	31.4498	31.3707	31.9358	31.8307	0.4860	0.4600	1.9440	1.8400
4	31.3613	31.4486	31.8281	31.9149	0.4668	0.4663	1.8672	1.8652
5	31.4691	31.5351	31.9143	31.9888	0.4452	0.4537	1.7808	1.8148
6	31.3625	31.4523	31.8094	31.9184	0.4469	0.4661	1.7876	1.8644

Table 183: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4521	31.1919	31.9165	31.6673	0.4644	0.4754	1.8576	1.9016
2	31.4609	31.3866	31.9305	31.8880	0.4696	0.5014	1.8784	2.0056
3	31.4462	31.3544	31.9023	31.8474	0.4561	0.4930	1.8244	1.9720
4	31.3468	31.1404	31.7894	31.6080	0.4426	0.4676	1.7704	1.8704
5	31.4680	31.3160	31.8963	31.8030	0.4283	0.4870	1.7132	1.9480
6	31.5315	31.3937	31.9662	31.8537	0.4347	0.4600	1.7388	1.8400

Table 184: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3839	31.4010	31.8121	31.8736	0.0615	0.4726	0.2460	1.8904
2	31.3645	31.3773	31.6123	31.8531	0.2478	0.4758	0.9912	1.9032
3	31.5171	31.4373	31.7661	31.9314	0.2490	0.4941	0.9960	1.9764
4	31.4105	31.2253	31.6554	31.7204	0.2449	0.4951	0.9796	1.9804
5	31.3647	31.3560	31.6350	31.8405	0.2703	0.4845	1.0812	1.9380
6	31.4617	31.1335	31.7400	31.6230	0.2783	0.4895	1.1132	1.9580

Table 185: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1993	31.1940	31.6909	31.6851	0.4916	0.4911	1.9664	1.9644
2	31.4693	31.3214	31.6686	31.6695	0.1993	0.3481	0.7972	1.3924
3	31.3505	31.4691	31.5576	31.8083	0.2071	0.3392	0.8284	1.3568
4	31.3670	31.4083	31.5663	31.7651	0.1993	0.3568	0.7972	1.4272
5	31.4592	31.0792	31.6463	31.4463	0.1871	0.3671	0.7484	1.4684
6	31.3173	31.0933	31.4975	31.4793	0.1802	0.3860	0.7208	1.5440

Table 186: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4052	31.4122	31.8347	31.8643	0.4295	0.4521	1.7180	6.8720
2	31.3259	31.3478	31.5653	31.7640	0.2394	0.4162	0.9576	3.8304
3	31.2788	31.3335	31.4680	31.6005	0.1892	0.2670	0.7568	3.0272
4	31.3640	31.4060	31.5695	31.6728	0.2055	0.2668	0.8220	3.2880
5	31.4026	31.5233	31.5690	31.7840	0.1664	0.2607	0.6656	2.6624
6	31.4130	31.4391	31.6181	31.6964	0.2051	0.2573	0.8204	3.2816

Table 187. Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 6('-'indicates No data available).

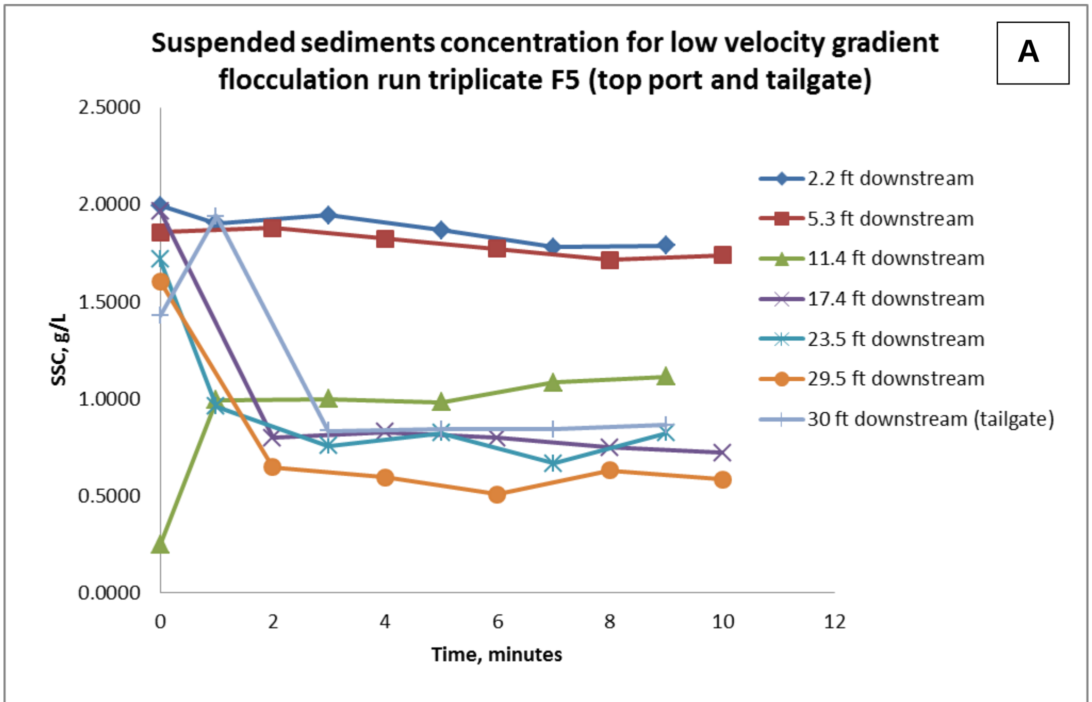
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4720	31.4094	31.8728	31.8664	0.4008	0.4570	1.6032	1.8280
2	31.3474	31.1885	31.5090	31.4707	0.1616	0.2822	0.6464	1.1288
3	31.3863	31.3669	31.5349	31.5851	0.1486	0.2182	0.5944	0.8728
4	31.3284	31.4236	31.4551	31.6387	0.1267	0.2151	0.5068	0.8604
5	31.1833	31.2109	31.3404	31.4390	0.1571	0.2281	0.6284	0.9124
6	31.3953	31.4554	31.5412	31.6771	0.1459	0.2217	0.5836	0.8868

Table 188: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	sediment concentration (g/L)
1	31.3880	31.7446	0.3566	1.4264
2	31.4165	31.9010	0.4845	1.9380
3	31.3855	31.5939	0.2084	0.8336
4	31.3931	31.6034	0.2103	0.8412
5	31.1751	31.3855	0.2104	0.8416
6	31.3647	31.5807	0.2160	0.8640

Table 189: Mass of the sediment settled in the trays for low velocity gradient flocculation run triplicate F5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.25	400.35	4.10
2	759.35	797.65	38.30
3	759.55	857.60	98.05
4	1519.90	1847.95	328.05
5	2280.80	2820.35	539.55
6	1521.15	1940.75	419.60
7	1521.70	1746.20	224.50
8	1521.80	1655.85	134.05
9	760.95	776.45	15.50
10	1520.85	1591.20	70.35
11	1520.50	1579.05	58.55



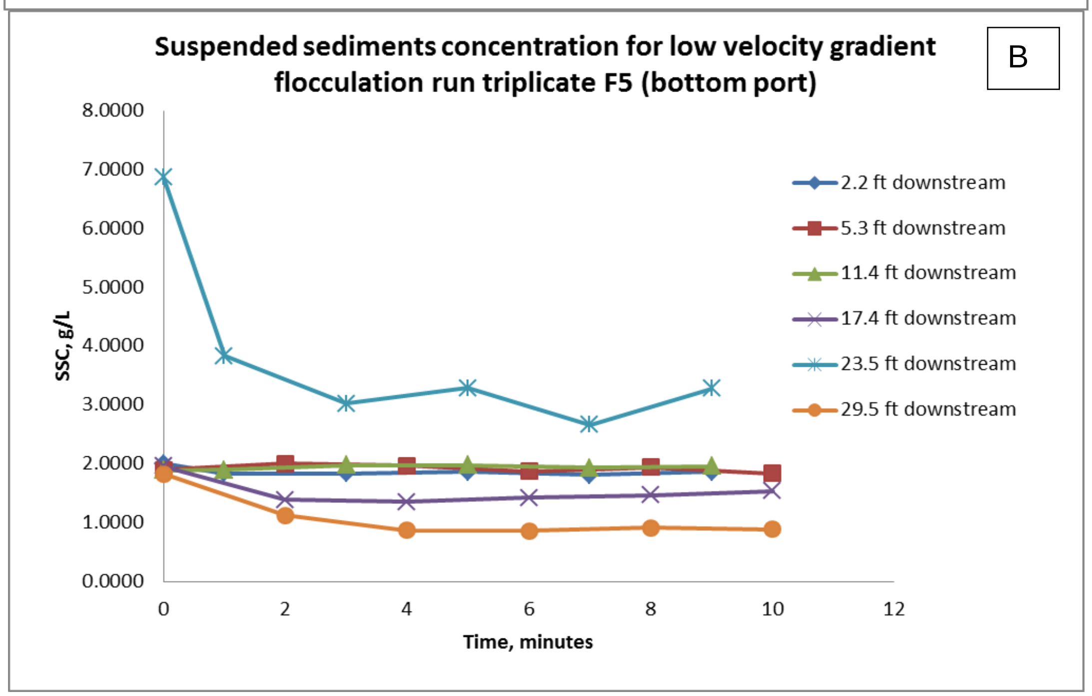


Figure 56: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

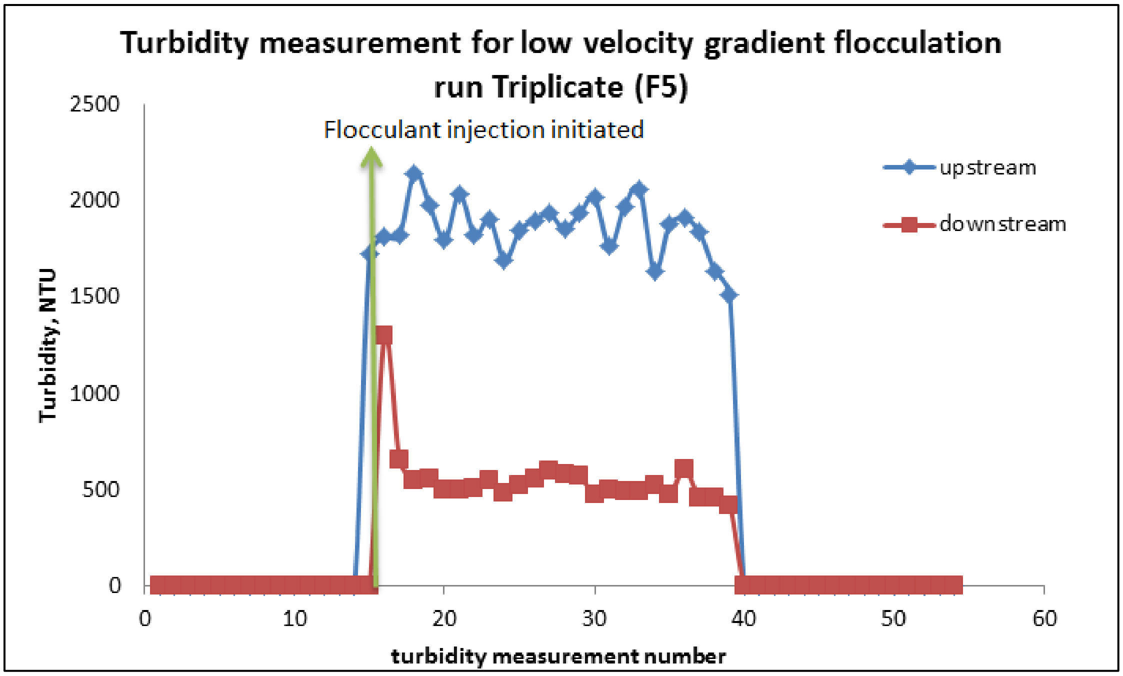


Figure 57. Upstream and downstream turbidity for low velocity gradient flocculation run triplicate F5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port B High Velocity Gradient Flocculation Run Triplicate (F6)</u>

The oscillating grid speed was set at 148 rpm. Tables 190 to 197 show the data related to this run, and Figure 58 shows the graph of the sediment concentration. Figure 59 shows the graph of the upstream and downstream turbidity. Figure 60 below summarizes the trapping efficiencies for the Port B soil and Table 54 shows the values of the stickiness coefficient obtained for Port B soil.

Table 190. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4236	26.3221	26.8780	26.7978	0.4544	0.4757	1.8176	1.9028
2	26.3974	26.5118	26.8722	26.9835	0.4748	0.4717	1.8992	1.8868
3	26.2801	26.2963	26.7634	26.7930	0.4833	0.4967	1.9332	1.9868
4	26.3077	26.3170	26.7861	26.8095	0.4784	0.4925	1.9136	1.9700
5	26.4148	26.3758	26.9053	26.8778	0.4905	0.5020	1.9620	2.0080
6	26.2755	26.3975	26.7713	26.8865	0.4958	0.4890	1.9832	1.9560

Table 191. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4646	26.4153	26.9493	26.8849	0.4847	0.4696	1.9388	1.8784
2	26.4338	26.4357	26.9204	26.9295	0.4866	0.4938	1.9464	1.9752
3	26.5152	26.3093	27.0026	26.7847	0.4874	0.4754	1.9496	1.9016
4	26.3195	26.2873	26.8034	26.7738	0.4839	0.4865	1.9356	1.9460
5	26.3036	26.4580	26.7881	26.9476	0.4845	0.4896	1.9380	1.9584
6	26.4209	26.3203	26.9080	26.8058	0.4871	0.4855	1.9484	1.9420

Table 192. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2996	26.4580	26.7573	26.9260	0.1687	0.4680	0.6748	1.8720
2	26.2668	26.2938	26.4990	26.7531	0.2322	0.4593	0.9288	1.8372
3	26.3213	26.4780	26.5511	26.9376	0.2298	0.4596	0.9192	1.8384
4	26.3690	26.1924	26.6176	26.6491	0.2486	0.4567	0.9944	1.8268
5	26.4465	26.4276	26.7009	26.8984	0.2544	0.4708	1.0176	1.8832
6	26.3514	26.3647	26.6067	27.0535	0.2553	0.6888	1.0212	2.7552

Table 193. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4056	26.2823	26.8788	26.7434	0.4732	0.4611	1.8928	1.8444
2	26.2659	26.3045	26.4506	26.5673	0.1847	0.2628	0.7388	1.0512
3	26.3186	26.3043	26.4887	26.5725	0.1701	0.2682	0.6804	1.0728
4	26.4310	26.4160	26.6040	26.6791	0.1730	0.2631	0.6920	1.0524
5	26.3682	26.4515	26.5506	26.7290	0.1824	0.2775	0.7296	1.1100
6	26.3772	-	26.5619	-	0.1847	-	0.7388	-

Table 194. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 5(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2762	26.3786	26.6950	26.8008	0.4188	0.4222	1.6752	6.7008
2	26.3043	26.4407	26.5575	26.8857	0.2532	0.4450	1.0128	4.0512
3	26.3111	26.3991	26.4706	26.6178	0.1595	0.2187	0.6380	2.5520
4	26.4091	26.3596	26.5761	26.5692	0.1670	0.2096	0.6680	2.6720
5	26.3099	26.3230	26.4719	26.5295	0.1620	0.2065	0.6480	2.5920
6	26.3278	26.4408	26.4953	26.6501	0.1675	0.2093	0.6700	2.6800

Table 195. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 6(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2540	26.4705	26.4911	26.7104	0.2371	0.2399	0.9484	0.9596
2	26.3692	26.3362	26.5322	26.6752	0.1630	0.3390	0.6520	1.3560
3	26.2624	26.3398	26.4191	26.5341	0.1567	0.1943	0.6268	0.7772
4	26.3298	26.3390	26.4758	26.5217	0.1460	0.1827	0.5840	0.7308
5	26.2732	26.3615	26.4306	26.5504	0.1574	0.1889	0.6296	0.7556
6	26.4421	26.2603	26.6002	26.4522	0.1581	0.1919	0.6324	0.7676

Table 196. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment concentration (g/L)
1	26.5140	26.7230	0.2090	0.8360
2	26.3379	26.7934	0.4555	1.8220
3	26.3860	26.5649	0.1789	0.7156
4	26.2895	26.4587	0.1692	0.6768
5	26.4314	26.5889	0.1575	0.6300
6	26.4398	26.6120	0.1722	0.6888

Table 197. Mass of the sediment settled in the trays for high velocity gradient flocculation run triplicate F6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)
1	760.60	766.65	6.05
2	760.55	838.75	78.20
3	1521.60	1741.40	219.80
4	2283.95	2801.15	517.20
5	2281.80	2780.25	498.45
6	1522.05	1902.80	380.75
7	1522.40	1707.80	185.40
8	1522.40	1650.75	128.35
9	1522.15	1592.80	70.65
10	1521.55	1573.25	51.70
11	1520.90	1561.50	40.60

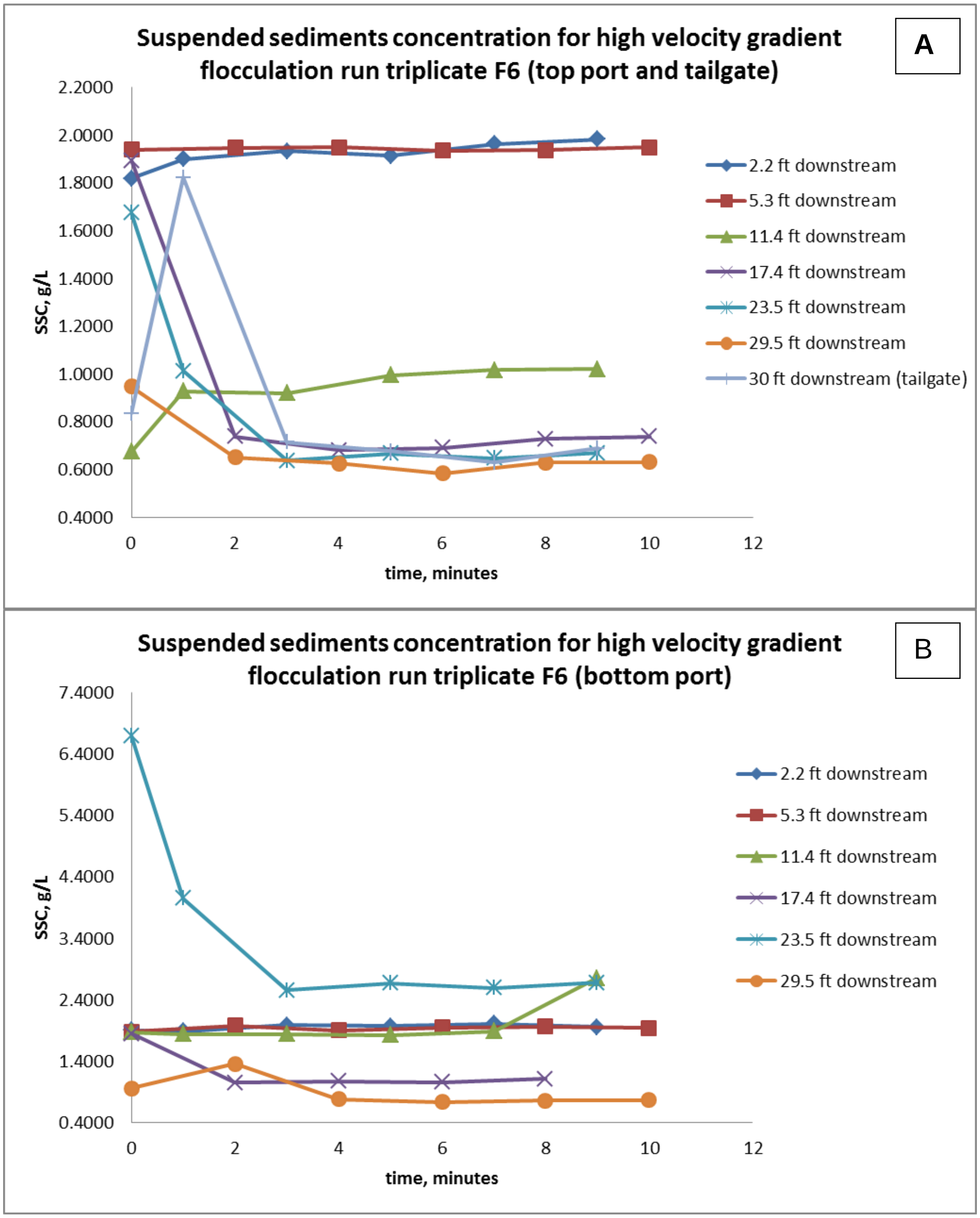


Figure 58: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

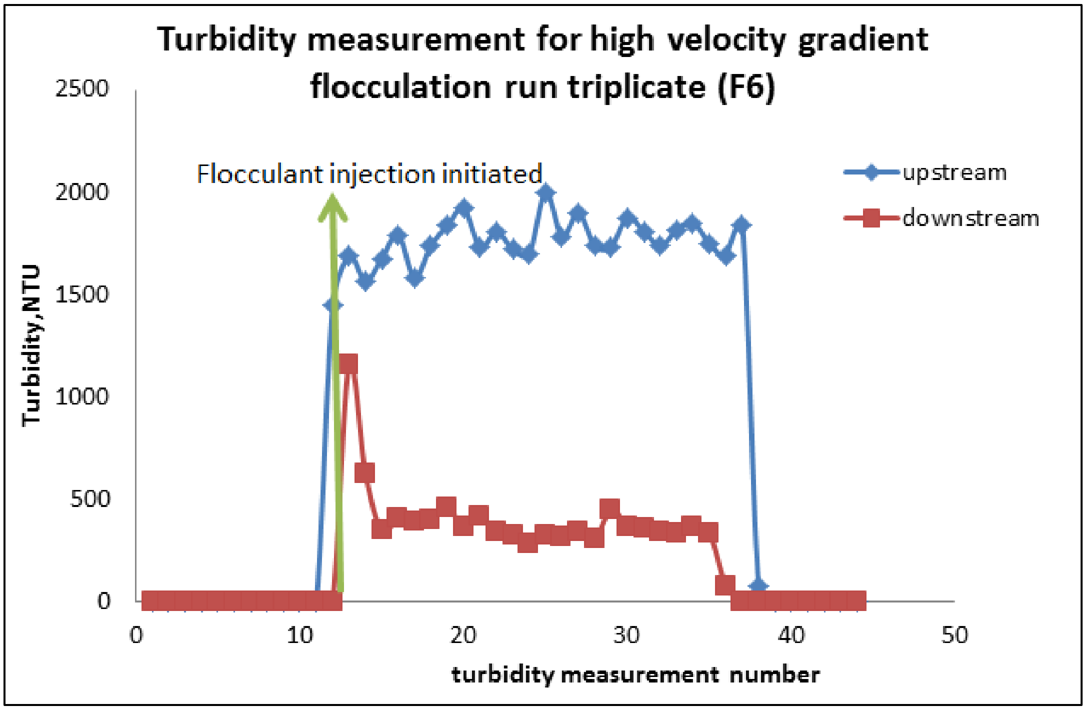


Figure 59: Graph of upstream and downstream turbidity measured for the high velocity gradient flocculation run triplicate F6.

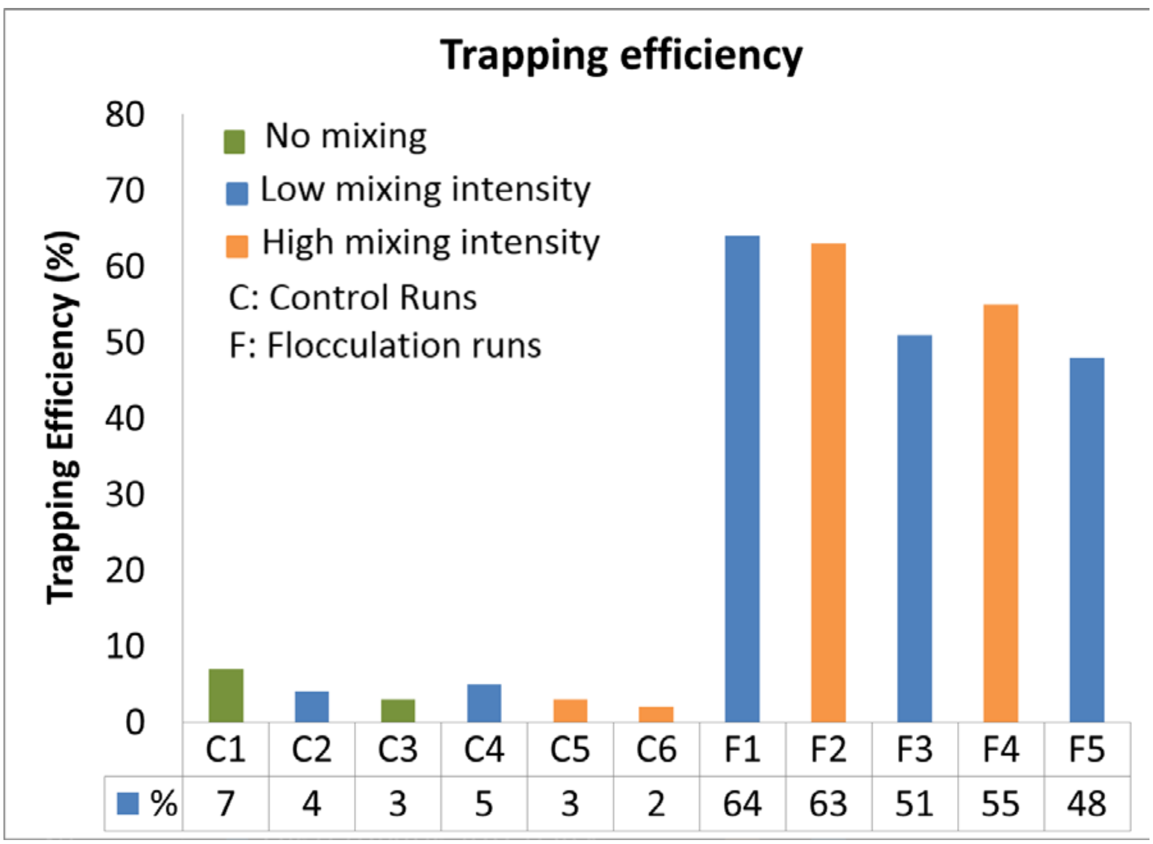


Figure 60.Trapping efficiencies for Port B soil.

Table 198. Values of the stickiness coefficient α for the Pacolet soil (F: Flocculation run; Number: Experiment run number)

Low Velocity Gradient Run	High Velocity Gradient Run
F1: α= 1.2	F2: α=1.2
F3 (duplicate): α= 1.15	F4 (duplicate): α= 1.5
F5 (triplicate): α=1.2	F6 (triplicate): α=3.5 (error on measurement)

Data Analysis for Kamie B Soil

In the following section, data for the suspended sediment concentration and the flocculation constants for the Kamie B soil are presented. The summary of all the experimental runs done on Kamie B soil is presented in Table 199.

Table 199. Summary of the experimental runs done on Port B soil ('-' indicates that no data available; NA: Not Applicable).

Run No.	Description	Oscillation speed (rpm)	Velocity gradient (sec^{-1})	Sediment flow rate (l/min)	Incoming sediment concentration (g/l)	Flow rate of water (l/min)	Flocculant concentration (g/L)
C1	Control Run without agitation	0	1.57	26.4	12.7	170	NA
C2	Low velocity gradient control run	99	104	14.4	12.3	170	NA
C3	High velocity gradient control run	0	1.57	33.0	15.68	170	NA
C4	Low velocity gradient control run duplicate	99	104	58.84	16.67	171	NA
C5	High velocity gradient control run duplicate	148	134	21.7	17.7	154.0	NA
C6	Control run without agitation duplicate	0	1.57	28.1	20.1	235.7	NA
F1	Low velocity gradient flocculation run	99	104	22.2	15.9	200.0	0.015
F2	High velocity gradient flocculation run	148	134	42.3	16.27	170.0	0.015
F3	Low velocity gradient flocculation run duplicate	99	104	42.3	15.9	192.00	0.015
F4	High velocity gradient flocculation run duplicate	148	134	25.5	17.1	203.2	0.015
F5	Low velocity gradient flocculation run triplicate	99	104	30.9	18.4	120	0.015
F6	High velocity gradient flocculation run triplicate	148	134	35.3	21.6	180.0	0.015

Kamie B Control Run without the Agitation C1

Tables 200 to 206 shows the sediment concentration measured all the six stations and the tailgate. Table 207 shows the mass of the sediment that settled in the trays at the bottom of the flume. Figure 61 shows the concentration of the sediment measured at the top and bottom ports, and Figure 62 shows the graph of the upstream and downstream turbidity measured throughout the run.

Table 200. Suspended sediment concentration for control run without agitation C1 at Station 1 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	26.3289	26.4092	26.8194	26.9484	0.4905	0.5392	1.9620	2.1568
2	26.3882	26.4405	26.9031	26.9977	0.5149	0.5572	2.0596	2.2288
3	26.4106	26.3602	26.9260	26.8923	0.5154	0.5321	2.0616	2.1284
4	26.3600	26.4065	26.8845	26.9296	0.5245	0.5231	2.0980	2.0924
5	26.2758	26.4343	26.7848	26.9670	0.5090	0.5327	2.0360	2.1308
6	26.3113	26.4571	26.8151	26.9861	0.5038	0.5290	2.0152	2.1160

Table 201. Suspended sediment concentration for control run without agitation C1 at Station 2 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	26.5163	26.4017	27.0356	26.9403	0.5193	0.5386	2.0772	2.1544
2	26.4318	26.4359	26.9303	26.9507	0.4985	0.5148	1.9940	2.0592
3	26.2804	26.4027	26.7885	26.9300	0.5081	0.5273	2.0324	2.1092
4	26.2949	26.2536	26.8033	26.7731	0.5084	0.5195	2.0336	2.0780
5	26.4440	26.3979	26.9489	26.9173	0.5049	0.5194	2.0196	2.0776
6	26.3603	26.4329	26.8647	26.9519	0.5044	0.5190	2.0176	2.0760

Table 202. Suspended sediment concentration for control run without agitation C1 at Station 3 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.4019	26.2682	26.8725	26.7853	0.4706	0.5171	1.8824	2.0684
2	26.4029	26.2977	26.9142	26.8186	0.5113	0.5209	2.0452	2.0836
3	26.2995	26.2888	26.8182	26.8134	0.5187	0.5246	2.0748	2.0984
4	26.4044	26.4033	26.8894	26.9059	0.4850	0.5026	1.9400	2.0104
5	26.4177	26.3175	26.9328	26.8485	0.5151	0.5310	2.0604	2.1240
6	26.3215	26.3925	26.8476	26.8328	0.5261	0.4403	2.1044	1.7612

Table 203. Suspended sediment concentration for control run without agitation C1 at Station 4 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.406	26.4134	26.8434	26.8537	0.4374	0.4403	1.7496	1.7612
2	26.2674	26.4187	26.7078	26.8716	0.4404	0.4529	1.7616	1.8116
3	26.4602	26.4646	26.9198	26.9313	0.4596	0.4667	1.8384	1.8668
4	26.2501	26.2937	26.7015	26.7596	0.4514	0.4659	1.8056	1.8636
5	26.4263	26.5202	26.8888	26.9965	0.4625	0.4763	1.8500	1.9052
6	26.3940	26.4039	26.8412	26.8705	0.4472	0.4666	1.7888	1.8664

Table 204. Suspended sediment concentration for control run without agitation C1 at Station 5 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4219	26.4376	26.8551	26.8826	0.4332	0.4450	1.7328	1.7800
2	26.3505	26.4094	26.7901	26.8677	0.4396	0.4583	1.7584	1.8332
3	26.3744	31.3200	26.8111	31.7512	0.4367	0.4312	1.7468	1.7248
4	31.2185	26.3124	31.6408	26.7592	0.4223	0.4468	1.6892	1.7872
5	26.2749	26.2426	26.7079	26.6901	0.4330	0.4475	1.7320	1.7900
6	31.3826	31.4806	31.8312	31.9542	0.4486	0.4736	1.7944	1.8944

Table 205. Suspended sediment concentration for control run without agitation C1 at Station 6 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5277	26.3788	26.9703	26.8360	0.4426	0.4572	1.7704	1.8288
2	26.2987	26.4773	26.7486	26.9652	0.4499	0.4879	1.7996	1.9516
3	31.3713	26.3212	31.8222	26.8190	0.4509	0.4978	1.8036	1.9912
4	26.5443	26.4792	27.0128	26.9869	0.4685	0.5077	1.8740	2.0308
5	26.3447	26.3569	26.8094	26.8618	0.4647	0.5049	1.8588	2.0196
6	31.3707	26.4433	31.8042	26.9412	0.4335	0.4979	1.7340	1.9916

Table 206. Suspended sediment concentration for control run without agitation C1 at tailgate ('-' indicates No data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.4083	26.8033	0.395	1.58
2	26.3142	26.775	0.4608	1.8432
3	26.4071	26.8702	0.4631	1.8524
4	26.3572	26.8284	0.4712	1.8848
5	26.3482	26.7974	0.4492	1.7968
6	26.3743	26.8147	0.4404	1.7616

Table 207: Mass of the sediment settled on the trays for the control run without agitation C1

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.25	404.45	11.2
2	832.6	858.25	25.65
3	872.45	898.6	26.15
4	829.1	857.35	28.25
5	827.2	854.4	27.2
6	789.8	817.85	28.05
7	393.7	416.4	22.7
8	1183.7	1210.1	26.4
9	786.85	817.2	30.35
10	6.75	22.4	15.65
11	759.9	783.4	23.5

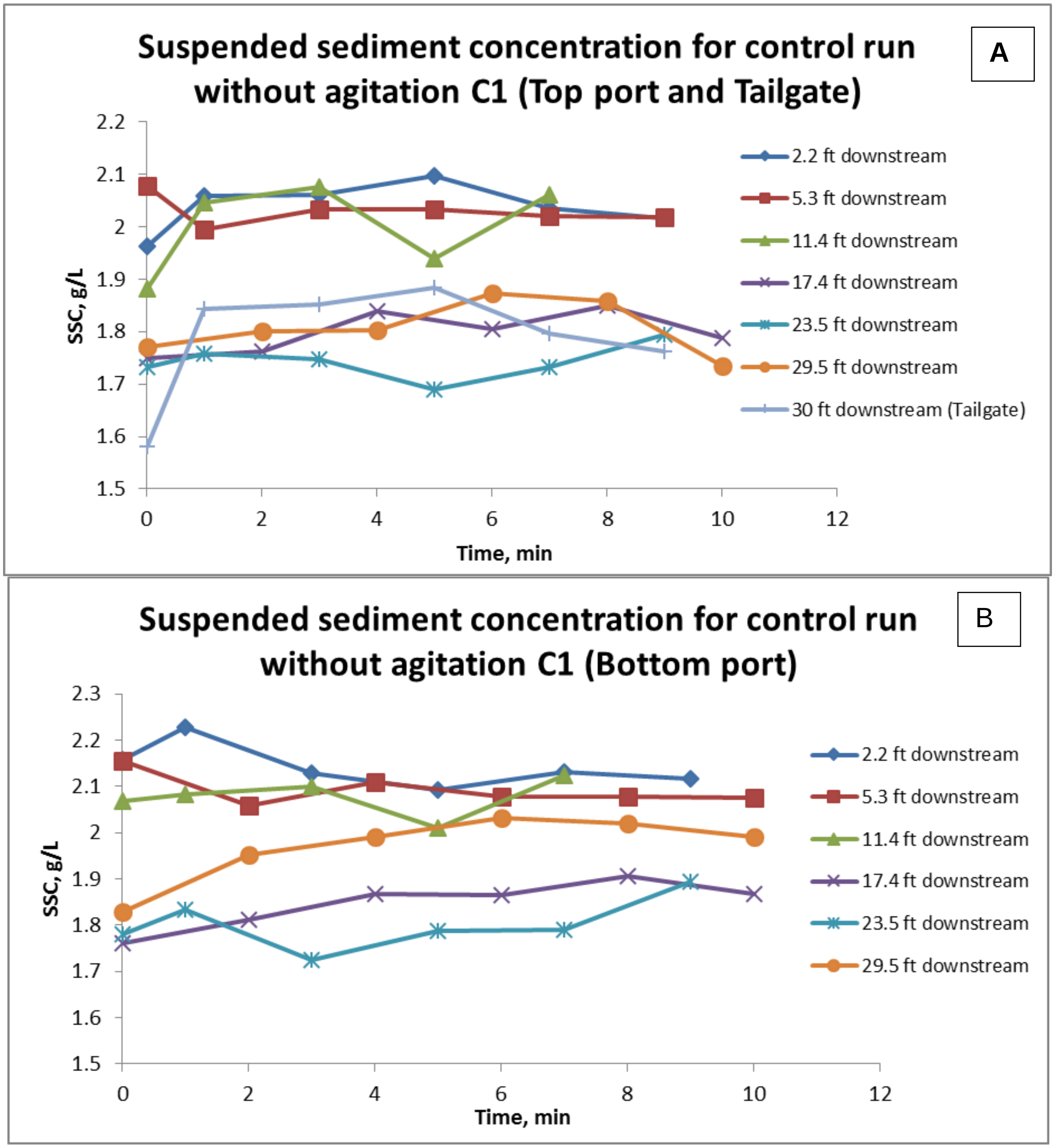


Figure 61. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

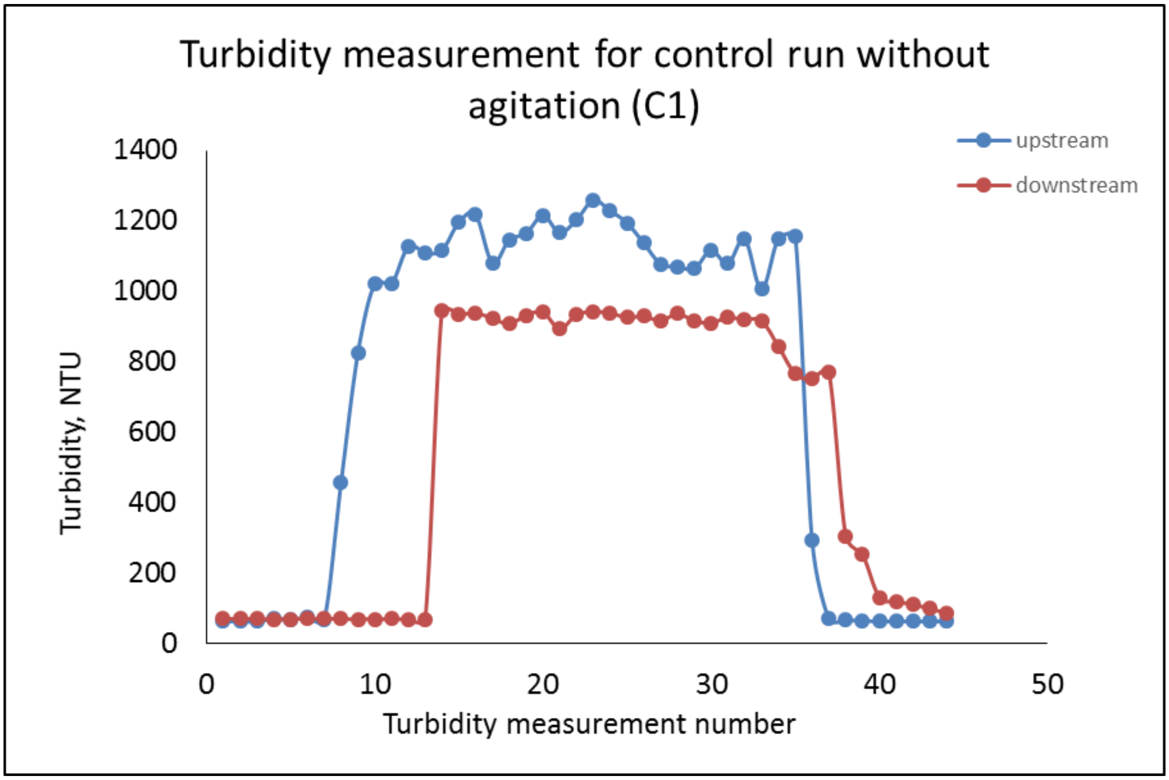


Figure 62. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument

<u>Kamie B Low Velocity Gradient Control Run (C2)</u>

Since the nature of the control run with agitation was the same for both soils, the speed of the oscillating grids for this run was set at 99 rpm. Tables 208 to 215 show the data related to the sediment concentration measured at the sampling ports, and mass of the flocculated matter that settled in the trays respectively.

Table 208. Suspended sediment concentration for low velocity gradient control run (C2).at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3872	26.9125	26.9297	26.9148	0.5425	0.0023	2.1700	0.0092
2	31.8894	26.8090	31.9477	26.8763	0.0583	0.0673	0.2332	0.2692
3	31.2285	31.7337	31.6480	31.9336	0.4195	0.1999	1.6780	0.7996
4	26.3035	26.2710	26.8126	26.7721	0.5091	0.5011	2.0364	2.0044
5	26.3868	26.1698	26.9006	26.6797	0.5138	0.5099	2.0552	2.0396
6	26.3108	26.4221	26.7945	26.9172	0.4837	0.4951	1.9348	1.9804

Table 209. Suspended sediment concentration for low velocity gradient control run (C2).at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6693	26.6023	26.9241	26.8320	0.2548	0.2297	1.0192	0.9188
2	26.2544	31.6967	26.7625	31.8226	0.5081	0.1259	2.0324	0.5036
3	26.3756	26.7145	26.9759	26.8475	0.6003	0.1330	2.4012	0.5320
4	26.7967	26.8794	26.9011	26.9640	0.1044	0.0846	0.4176	0.3384
5	31.7714	31.8431	31.9055	31.8504	0.1341	0.0073	0.5364	0.0292
6	31.2188	26.3443	31.7019	26.7906	0.4831	0.4463	1.9324	1.7852

Table 210. Suspended sediment concentration for low velocity gradient control run (C2).at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.2825	26.8046	26.7635	27.0000	0.4810	0.1954	1.9240	0.7816
2	26.7962	31.8214	27.0023	31.8471	0.2061	0.0257	0.8244	0.1028
3	31.3739	31.3190	31.8193	31.8186	0.4454	0.4996	1.7816	1.9984
4	26.3133	26.4224	26.8028	26.8852	0.4895	0.4628	1.9580	1.8512
5	26.4450	26.2503	26.9763	26.7875	0.5313	0.5372	2.1252	2.1488
6	26.7196	31.3833	26.9303	31.9060	0.2107	0.5227	0.8428	2.0908

Table 211. Suspended sediment concentration for low velocity gradient control run (C2).at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.4556	26.3190	27.0208	26.9014	0.5652	0.5824	2.2608	2.3296
2	26.5171	31.4875	27.0007	31.9927	0.4836	0.5052	1.9344	2.0208
3	26.5160	26.0209	27.0009	26.9149	0.4849	0.8940	1.9396	3.5760
4	31.8300	26.4252	32.0157	26.8889	0.1857	0.4637	0.7428	1.8548
5	31.8229	26.4439	31.9560	26.7749	0.1331	0.3310	0.5324	1.3240
6	26.4450	27.1392	26.7694	27.9598	0.3244	0.8206	1.2976	3.2824

Table 212. Suspended sediment concentration for low velocity gradient control run (C2).at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3815	26.3461	31.7969	26.9440	0.4154	0.5979	1.6616	2.3916
2	26.2928	26.3083	26.7287	27.1392	0.4359	0.8309	1.7436	3.3236
3	26.4861	26.3275	26.9479	26.8274	0.4618	0.4999	1.8472	1.9996
4	31.2105	26.2745	31.6544	26.7900	0.4439	0.5155	1.7756	2.0620
5	26.5704	26.2516	26.9408	26.6636	0.3704	0.4120	1.4816	1.6480
6	26.5301	26.3931	26.7113	26.7984	0.1812	0.4053	0.7248	1.6212

Table 213. Suspended sediment concentration for low velocity gradient control run (C2).at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2610	31.4448	26.4910	32.0735	0.2300	0.6287	0.9200	2.5148
2	26.4447	31.4402	26.9157	31.9456	0.4710	0.5054	1.8840	2.0216
3	26.2327	31.1450	26.7042	31.6385	0.4715	0.4935	1.8860	1.9740
4	31.4701	26.3345	31.9211	26.8411	0.4510	0.5066	1.8040	2.0264
5	26.4229	26.5015	26.8585	26.9799	0.4356	0.4784	1.7424	1.9136
6	31.4715	31.4233	31.9184	31.8959	0.4469	0.4726	1.7876	1.8904

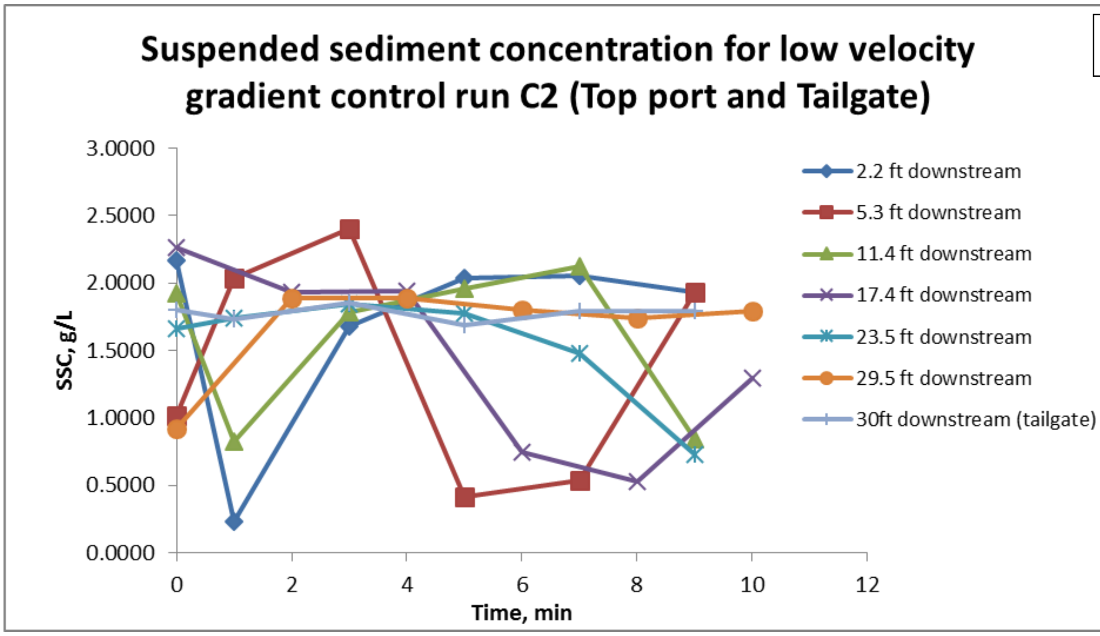
Table 214. Suspended sediment concentration for low velocity gradient control run (C2).at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.2757	26.7266	0.4509	1.8036
2	31.3817	31.8150	0.4333	1.7332
3	26.4822	26.9456	0.4634	1.8536
4	31.3714	31.7936	0.4222	1.6888
5	31.1444	31.5921	0.4477	1.7908
6	26.2756	26.7228	0.4472	1.7888

Table 215. Mass of the sediment settled in the trays for low velocity gradient control run (C2).

Tray no	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)
1	433.90	441.20	7.30
2	827.40	846.30	18.90
3	866.30	889.80	23.50
4	864.95	891.95	27.00
5	869.95	893.45	23.50
6	760.10	787.60	27.50
7	434.85	454.65	19.80
8	759.50	783.25	23.75
9	6.65	25.50	18.85
10	6.50	25.95	19.45
11	759.90	783.15	23.25

Figure 63 below shows the graph of the sediment concentration for this run, and Figure 64 shows the graph of the upstream and downstream turbidity.



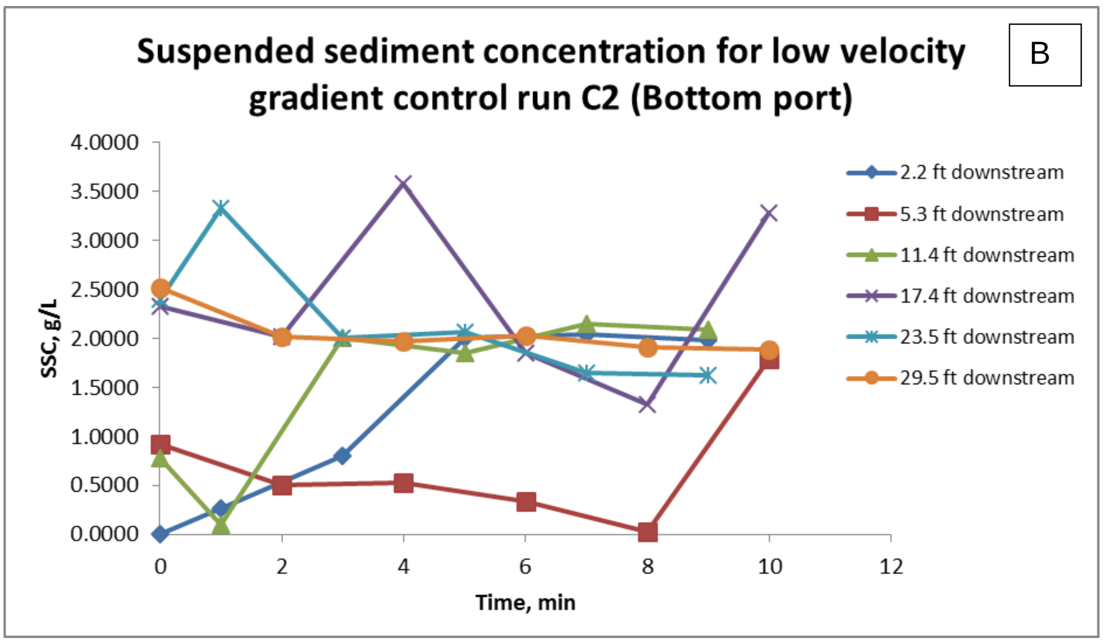


Figure 63. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1-minute interval from odd numbered and even numbered stations alternately

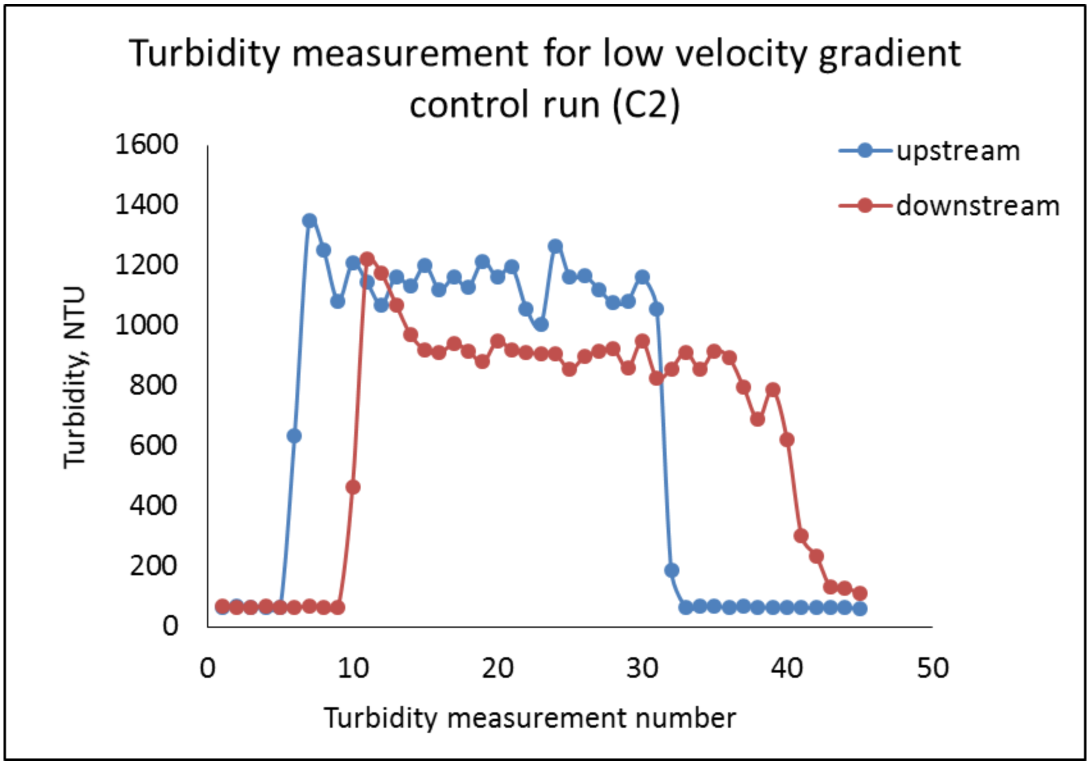


Figure 64. Upstream and downstream turbidity for low velocity gradient control run C2. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Kamie B High velocity gradient control run (C3)</u>

Tables 216 to 222 shows the data for the concentration of the suspended sediments, and Table 223 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 65 and 66 shows the graph of the suspended sediment concentration and the measured upstream and downstream turbidity

Table 216. Suspended sediment concentration for high velocity gradient control run C3 at Station 1('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5029	26.9426	31.9965	27.0382	0.4936	0.0956	1.9744	0.3824
2	26.3493	26.5755	26.9050	26.9421	0.5557	0.3666	2.2228	1.4664
3	31.6653	26.8647	31.9982	26.9081	0.3329	0.0434	1.3316	0.1736
4	26.7166	26.7607	27.0370	26.9333	0.3204	0.1726	1.2816	0.6904
5	26.6392	26.6377	26.9735	26.9916	0.3343	0.3539	1.3372	1.4156
6	26.7736	26.5636	27.0151	26.9592	0.2415	0.3956	0.9660	1.5824

Table 217. Suspended sediment concentration for high velocity gradient control run C3 at Station 2('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4812	26.5047	26.9712	26.8496	0.4900	0.3449	1.9600	1.3796
2	26.9255	31.7386	27.1656	32.1269	0.2401	0.3883	0.9604	1.5532
3	26.5610	26.7966	26.8789	27.1299	0.3179	0.3333	1.2716	1.3332
4	26.3663	26.5022	26.9051	26.9413	0.5388	0.4391	2.1552	1.7564
5	26.6988	26.6136	26.9314	27.0851	0.2326	0.4715	0.9304	1.8860
6	26.6331	26.5191	27.0219	27.0683	0.3888	0.5492	1.5552	2.1968

Table 218. Suspended sediment concentration for high velocity gradient control run C3 at Station 3('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6906	26.4444	26.8591	26.9417	0.1685	0.4973	0.6740	1.9892
2	26.6674	31.7741	26.9730	31.9877	0.3056	0.2136	1.2224	0.8544
3	32.0432	26.6290	32.0707	27.0799	0.0275	0.4509	0.1100	1.8036
4	31.6910	26.3443	31.9726	26.8610	0.2816	0.5167	1.1264	2.0668
5	26.3314	26.6954	26.8981	27.0712	0.5667	0.3758	2.2668	1.5032
6	31.6170	26.8981	32.1036	27.1870	0.4866	0.2889	1.9464	1.1556

Table 219. Suspended sediment concentration for high velocity gradient control run C3 at Station 4('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6481	26.9672	26.9663	27.0427	0.3182	0.0755	1.2728	0.3020
2	26.3886	26.4435	26.9097	27.0028	0.5211	0.5593	2.0844	2.2372
3	26.7278	26.7520	26.8908	26.9593	0.1630	0.2073	0.6520	0.8292
4	26.6927	26.4605	26.8904	26.9720	0.1977	0.5115	0.7908	2.0460
5	26.7950	26.8382	26.8599	26.9834	0.0649	0.1452	0.2596	0.5808
6	26.8868	26.7590	27.0121	26.8622	0.1253	0.1032	0.5012	0.4128

Table 220. Suspended sediment concentration for high velocity gradient control run C3 at Station 5('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.7599	26.6939	26.8884	26.9305	0.1285	0.2366	0.5140	0.9464
2	26.5832	26.5323	26.9843	27.0290	0.4011	0.4967	1.6044	1.9868
3	26.4927	26.2402	26.9386	26.8959	0.4459	0.6557	1.7836	2.6228
4	26.4982	26.5912	26.8837	27.0503	0.3855	0.4591	1.5420	1.8364
5	26.5222	26.7082	26.9971	27.0558	0.4749	0.3476	1.8996	1.3904
6	26.6873	26.6152	27.0115	27.0868	0.3242	0.4716	1.2968	1.8864

Table 221. Suspended sediment concentration for high velocity gradient control run C3 at Station 6('-' indicates no data).

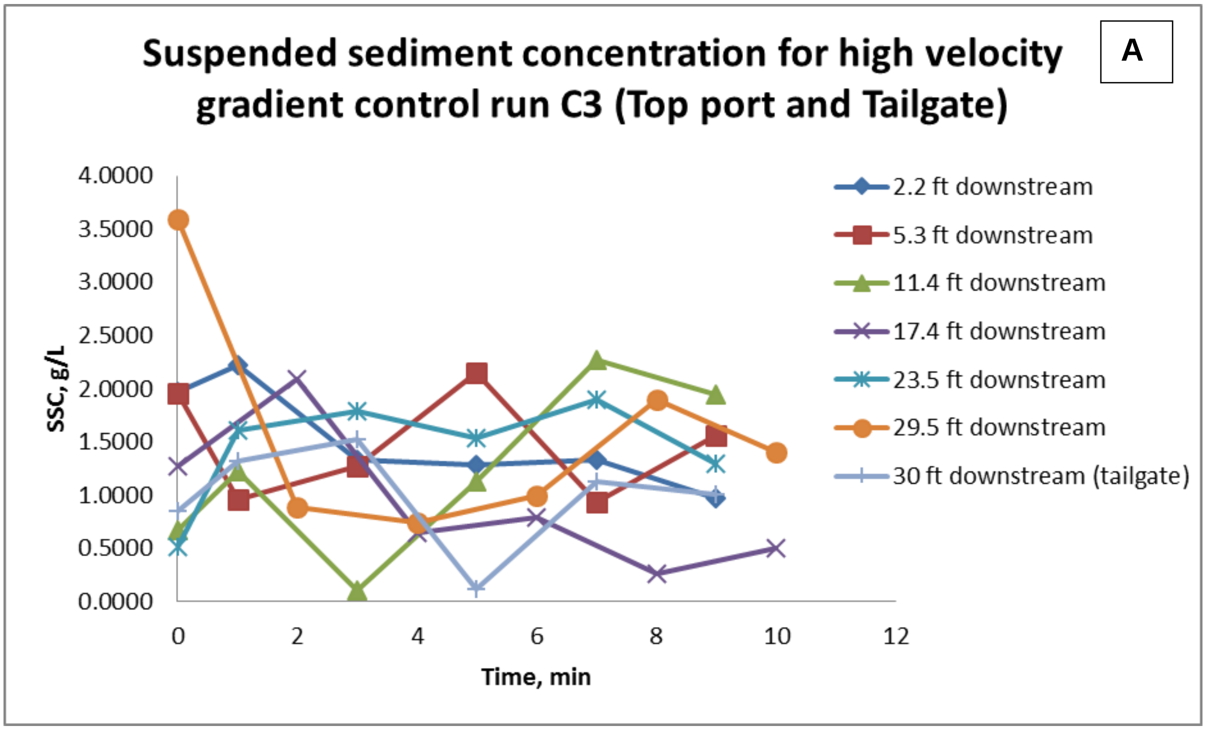
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	27.0552	26.2788	27.9547	26.8928	0.8995	0.6140	3.5980	2.4560
2	26.6677	26.8030	26.8880	27.0056	0.2203	0.2026	0.8812	0.8104
3	26.7431	26.5844	26.9298	26.9961	0.1867	0.4117	0.7468	1.6468
4	26.6027	26.3428	26.8526	26.8777	0.2499	0.5349	0.9996	2.1396
5	26.4439	26.5094	26.9172	26.9354	0.4733	0.4260	1.8932	1.7040
6	26.5630	26.6352	26.9127	27.0508	0.3497	0.4156	1.3988	1.6624

Table 222. Suspended sediment concentration for high velocity gradient control run C3 at tailgate('-' indicates no data).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.7696	26.9830	0.2134	0.8536
2	26.5473	26.8775	0.3302	1.3208
3	26.5185	26.8996	0.3811	1.5244
4	26.8921	26.9228	0.0307	0.1228
5	26.5109	26.7935	0.2826	1.1304
6	26.8440	27.0966	0.2526	1.0104

Table 223. Mass of settled sediments in the trays for high velocity gradient control run C3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	434.8	452.55	17.75
2	827.75	866.15	38.4
3	830.7	885.25	54.55
4	792.3	846.8	54.5
5	792.3	844	51.7
6	829.2	886.1	56.9
7	393.45	447.05	53.6
8	786.85	837.55	50.7
9	828.3	882.2	53.9
10	1221.15	1270.35	49.2
11	869.15	915.55	46.4



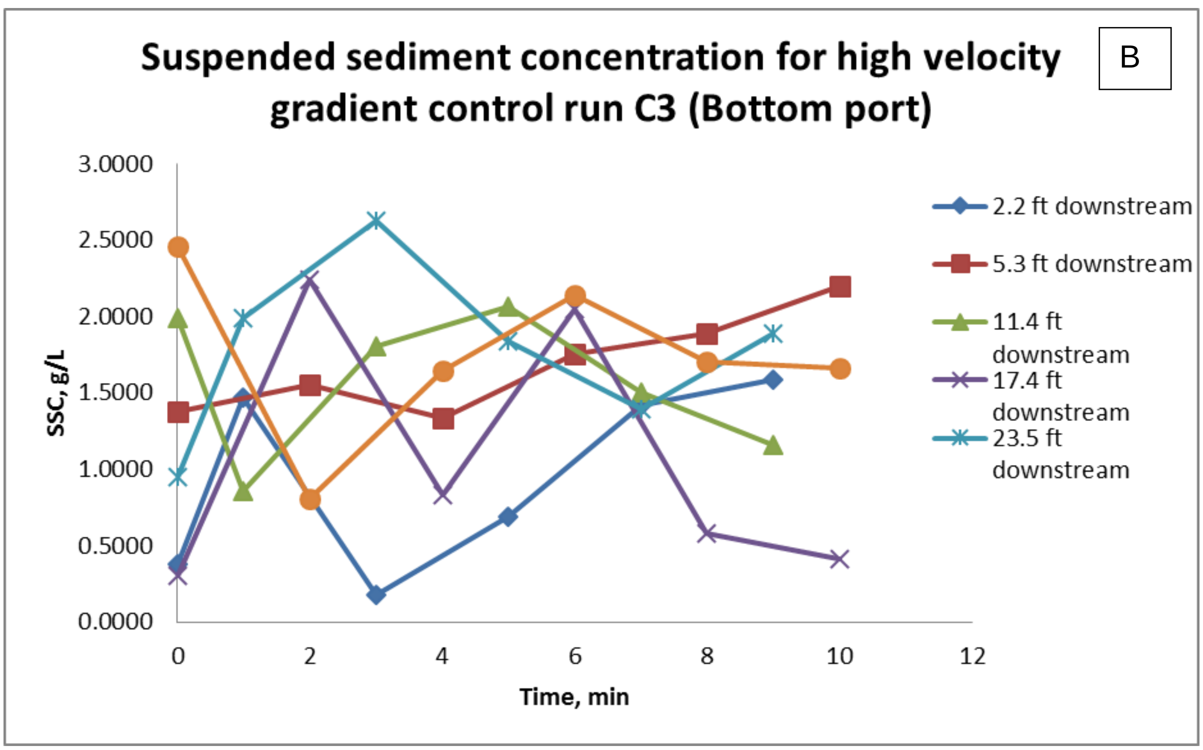


Figure 65. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

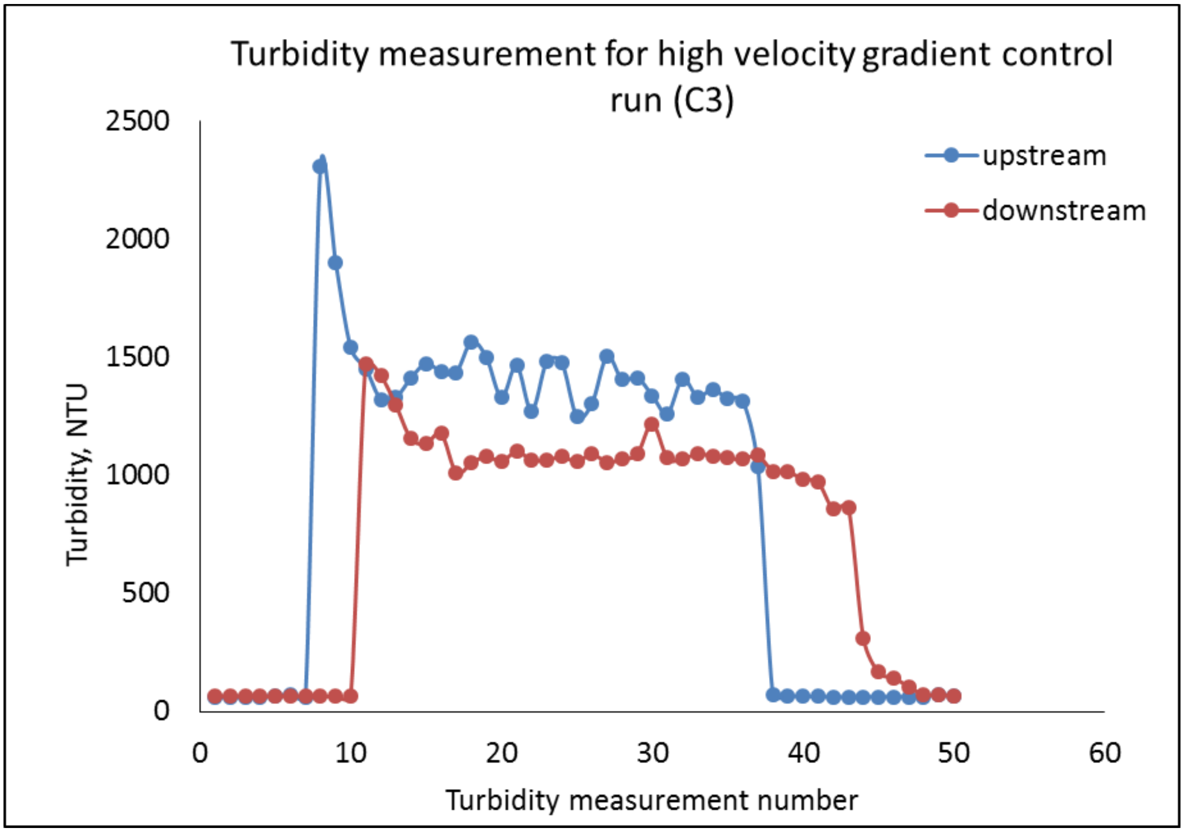


Figure 66. Upstream and downstream turbidity for high velocity gradient control run C3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Kamie B Low Velocity Gradient Control Run Duplicate (C4)</u>

The speed of the oscillating grids was set at 99 rpm. Tables 224 to 133 show the data related to the low velocity gradient control run C4, and Figure 47 shows the graph of the suspended sediment concentration. Figure 67 shows the graph of the upstream and downstream turbidity measured for this run and Figure 68 shows the measured upstream and downstream turbidity

Table 224. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4616	26.4053	26.8777	26.9098	0.4161	0.5045	1.6644	2.0180
2	26.2820	26.4523	26.8358	26.9094	0.5538	0.4571	2.2152	1.8284
3	26.3616	26.4324	26.9331	26.9974	0.5715	0.5650	2.2860	2.2600
4	26.2771	26.3165	26.8569	26.8958	0.5798	0.5793	2.3192	2.3172
5	26.5446	26.4768	27.0814	26.9234	0.5368	0.4466	2.1472	1.7864
6	26.4283	26.4542	26.9845	27.0315	0.5562	0.5773	2.2248	2.3092

Table 225. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3602	26.3129	26.8170	26.8425	0.4568	0.5296	1.8272	2.1184
2	26.2499	26.3554	26.8666	26.8936	0.6167	0.5382	2.4668	2.1528
3	26.4705	26.3460	27.0001	26.8087	0.5296	0.4627	2.1184	1.8508
4	26.4428	26.3162	27.0462	26.6945	0.6034	0.3783	2.4136	1.5132
5	26.2800	26.4542	26.8465	26.8022	0.5665	0.3480	2.2660	1.3920
6	31.2387	26.3354	31.8173	26.7648	0.5786	0.4294	2.3144	1.7176

Table 226. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3140	26.2456	26.8509	26.8153	0.5369	0.5697	2.1476	2.2788
2	31.3800	31.5034	31.9102	32.0415	0.5302	0.5381	2.1208	2.1524
3	31.4729	26.4359	32.0133	26.9938	0.5404	0.5579	2.1616	2.2316
4	26.3500	26.4703	26.8527	26.9762	0.5027	0.5059	2.0108	2.0236
5	26.4930	31.4423	27.0288	32.0040	0.5358	0.5617	2.1432	2.2468
6	31.2484	31.4150	31.7869	31.9646	0.5385	0.5496	2.1540	2.1984

Table 227. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4856	31.2744	27.0213	31.8051	0.5357	0.5307	2.1428	2.1228
2	31.4855	31.1890	32.0349	31.7488	0.5494	0.5598	2.1976	2.2392
3	26.2614	26.3149	26.8206	26.8605	0.5592	0.5456	2.2368	2.1824
4	26.2910	26.2969	26.8497	26.9147	0.5587	0.6178	2.2348	2.4712
5	26.4781	31.4141	27.0303	32.0018	0.5522	0.5877	2.2088	2.3508
6	26.3712	26.4167	26.9005	27.0351	0.5293	0.6184	2.1172	2.4736

Table 228. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2853	26.4039	26.7423	26.9654	0.4570	0.5615	1.8280	2.2460
2	31.4048	31.4436	31.9149	32.0000	0.5101	0.5564	2.0404	2.2256
3	26.3724	31.3635	26.8920	31.9121	0.5196	0.5486	2.0784	2.1944
4	26.3992	31.1762	26.9329	31.7598	0.5337	0.5836	2.1348	2.3344
5	31.3924	31.4861	31.9278	32.0769	0.5354	0.5908	2.1416	2.3632
6	26.3849	31.4057	26.8852	31.9850	0.5003	0.5793	2.0012	2.3172

Table 229. Suspended sediment concentration for low velocity gradient control run duplicate C4.at Station 6

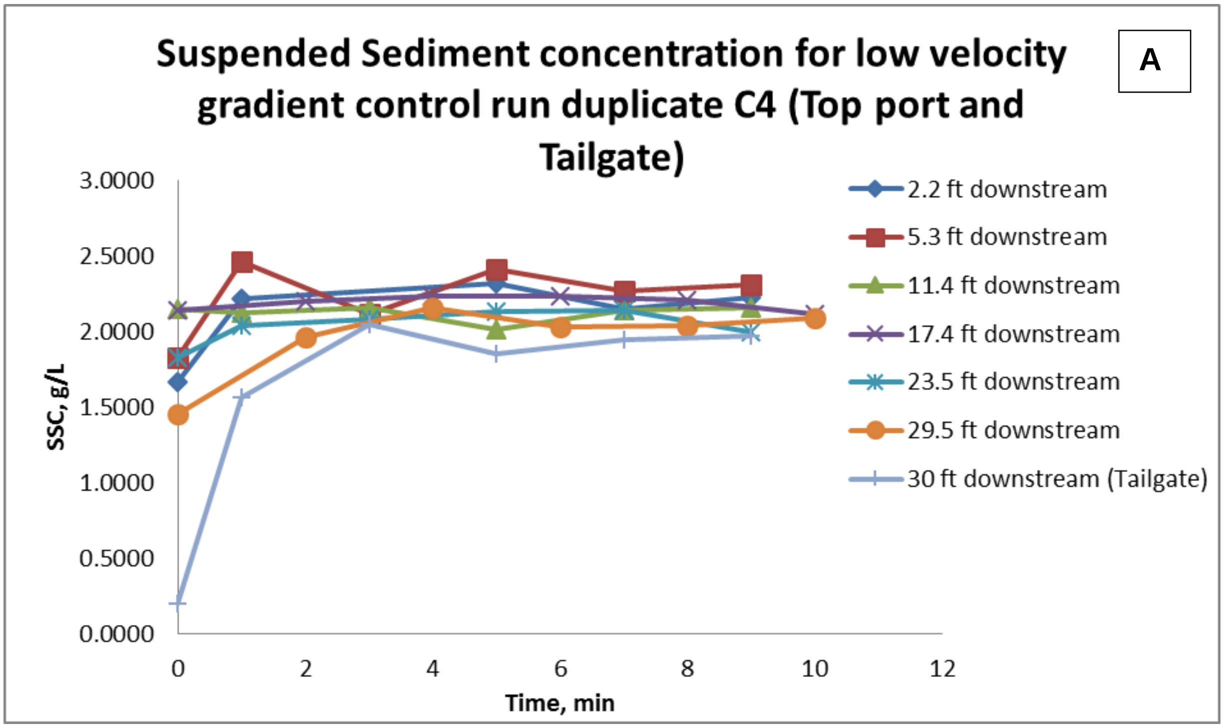
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2777	31.4009	26.6409	31.9104	0.3632	0.5095	1.4528	2.0380
2	26.3216	31.4485	26.8133	32.0057	0.4917	0.5572	1.9668	2.2288
3	26.2410	26.3984	26.7813	26.9556	0.5403	0.5572	2.1612	2.2288
4	26.3189	26.3490	26.8265	26.9071	0.5076	0.5581	2.0304	2.2324
5	26.3836	31.4419	26.8925	32.0149	0.5089	0.5730	2.0356	2.2920
6	26.2883	26.3758	26.8119	26.9123	0.5236	0.5365	2.0944	2.1460

Table 230. Suspended sediment concentration for low velocity gradient control run duplicate C4.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	sediment Concentration g/L
1	26.4242	26.4751	0.0509	0.2036
2	26.3312	26.7215	0.3903	1.5612
3	31.3741	31.8869	0.5128	2.0512
4	31.4461	31.9099	0.4638	1.8552
5	26.3760	26.8618	0.4858	1.9432
6	26.3507	26.8443	0.4936	1.9744

Table 231. Mass of settled sediments in the trays for low velocity gradient control run duplicate C4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)
1	393.45	408.45	15.00
2	865.95	903.70	37.75
3	868.40	910.35	41.95
4	869.30	910.15	40.85
5	760.25	804.85	44.60
6	760.40	805.00	44.60
7	760.00	798.00	38.00
8	760.25	800.35	40.10
9	759.95	799.05	39.10
10	760.85	795.05	34.20
11	759.95	792.90	32.95



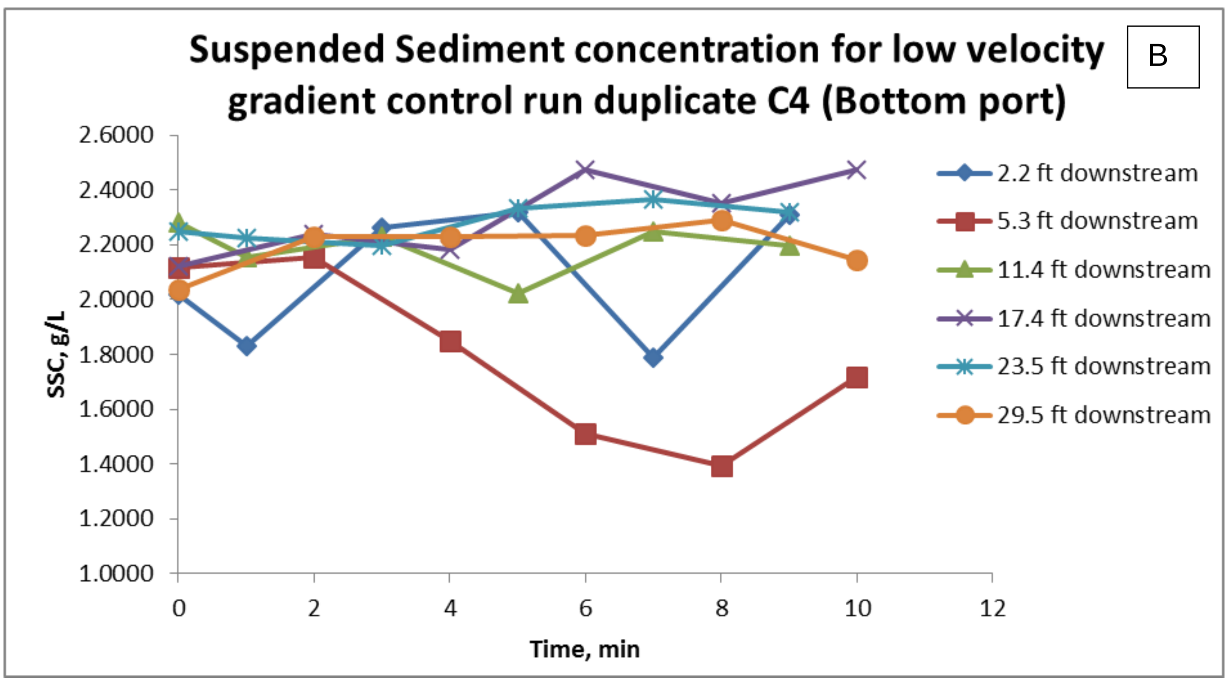


Figure 67. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

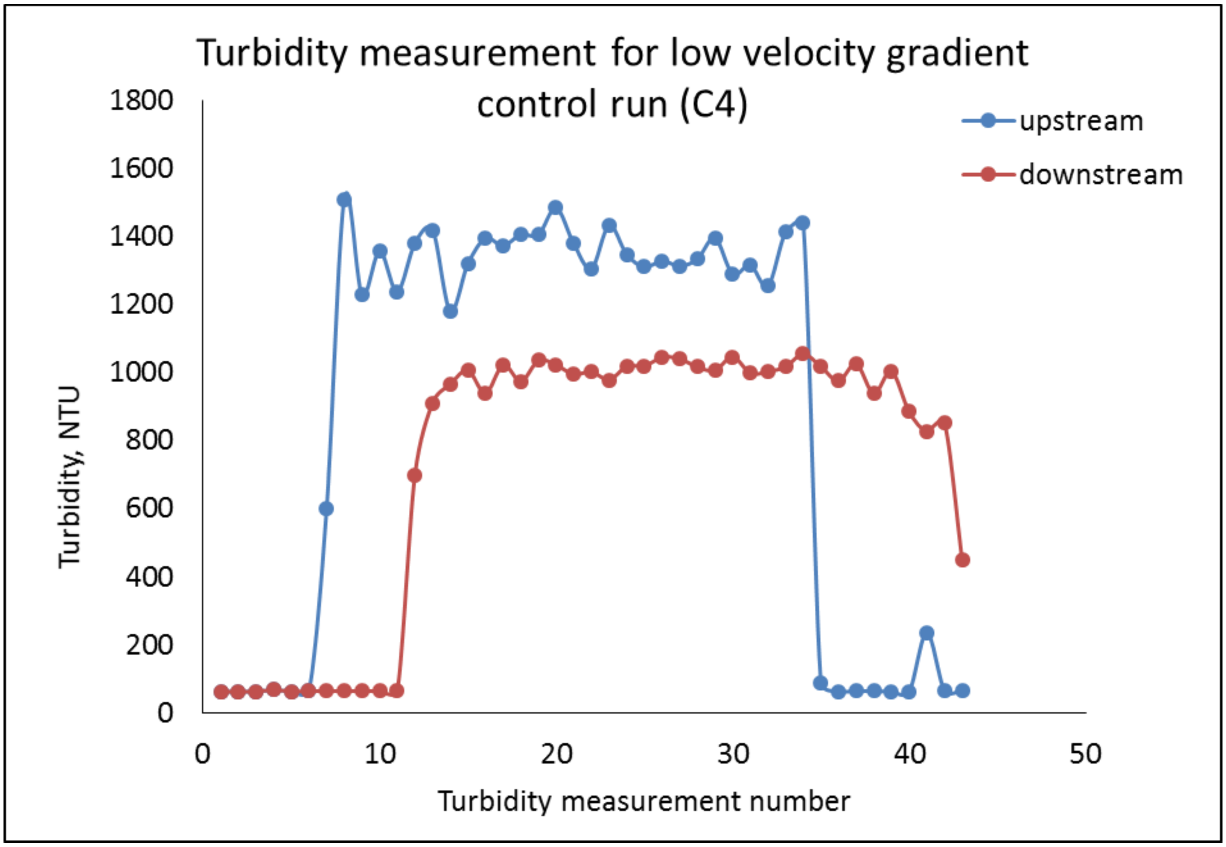


Figure 68. Upstream and downstream turbidity for low velocity gradient control run duplicate C4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Port B High Velocity Gradient Control Run duplicate C5</u>

The speed of the oscillating grids was set at 148 rpm. Tables 232 to 239 show the measured data for this run, and Figure 69 shows the graph of the sediment concentration.

Table 232. Suspended sediment concentration for high velocity gradient control run C5 at Station 1('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3272	26.2851	31.9722	26.9389	0.6450	0.6538	2.5800	2.6152
2	31.3976	26.3042	32.0239	26.9519	0.6263	0.6477	2.5052	2.5908
3	26.4155	26.2993	27.0498	26.9443	0.6343	0.6450	2.5372	2.5800
4	31.4026	26.2811	32.0189	26.9110	0.6163	0.6299	2.4652	2.5196
5	26.4015	31.3801	27.0391	31.9895	0.6376	0.6094	2.5504	2.4376
6	26.3358	26.3610	26.9610	26.9907	0.6252	0.6297	2.5008	2.5188

Table 233. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 2('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1565	26.5490	31.7299	27.1721	0.5734	0.6231	2.2936	2.4924
2	26.4119	26.2769	27.0444	26.9240	0.6325	0.6471	2.5300	2.5884
3	31.3802	26.2758	31.9788	26.9090	0.5986	0.6332	2.3944	2.5328
4	26.2421	31.1798	26.8814	31.8204	0.6393	0.6406	2.5572	2.5624
5	26.3834	26.2993	27.0221	26.9388	0.6387	0.6395	2.5548	2.5580
6	26.2628	26.4481	26.8943	27.0906	0.6315	0.6425	2.5260	2.5700

Table 234. Suspended sediment concentration for high velocity gradient control run duplicate C5 at Station 3('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3895	26.3360	32.0184	26.9809	0.6289	0.6449	2.5156	2.5796
2	26.2320	26.2967	26.8796	26.9455	0.6476	0.6488	2.5904	2.5952
3	26.3075	31.4063	26.9551	32.0157	0.6476	0.6094	2.5904	2.4376
4	31.5734	31.1539	32.0881	31.7636	0.5147	0.6097	2.0588	2.4388
5	26.4353	31.4966	27.0838	32.1105	0.6485	0.6139	2.5940	2.4556
6	26.2852	26.4583	26.9393	27.1133	0.6541	0.6550	2.6164	2.6200

Table 235. Suspended sediment concentration for high velocity gradient control run C5 at Station 4('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2318	31.3561	31.8385	31.9705	0.6067	0.6144	2.4268	2.4576
2	26.4073	26.3715	27.0189	27.0076	0.6116	0.6361	2.4464	2.5444
3	26.3449	26.3218	-	26.9565	-	0.6347	-	2.5388
4	26.3549	31.4718	26.9893	32.0943	0.6344	0.6225	2.5376	2.4900
5	26.3316	26.2874	26.9483	26.9341	0.6167	0.6467	2.4668	2.5868
6	26.2740	26.4443	26.9073	27.0955	0.6333	0.6512	2.5332	2.6048

Table 236. Suspended sediment concentration for high velocity gradient control run C5 at Station 5('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3992	31.3869	31.9440	31.9974	0.5448	0.6105	2.1792	2.4420
2	31.4449	31.4849	32.0581	32.1219	0.6132	0.6370	2.4528	2.5480
3	31.4679	31.5314	32.0729	32.1743	0.6050	0.6429	2.4200	2.5716
4	31.4008	26.2746	31.9713	26.9237	0.5705	0.6491	2.2820	2.5964
5	31.3580	26.4964	31.9527	27.1510	0.5947	0.6546	2.3788	2.6184
6	31.3722	31.1983	31.9692	31.8359	0.5970	0.6376	2.3880	2.5504

Table 237. Suspended sediment concentration for high velocity gradient control run C5 at Station 6('-' indicates no data available).

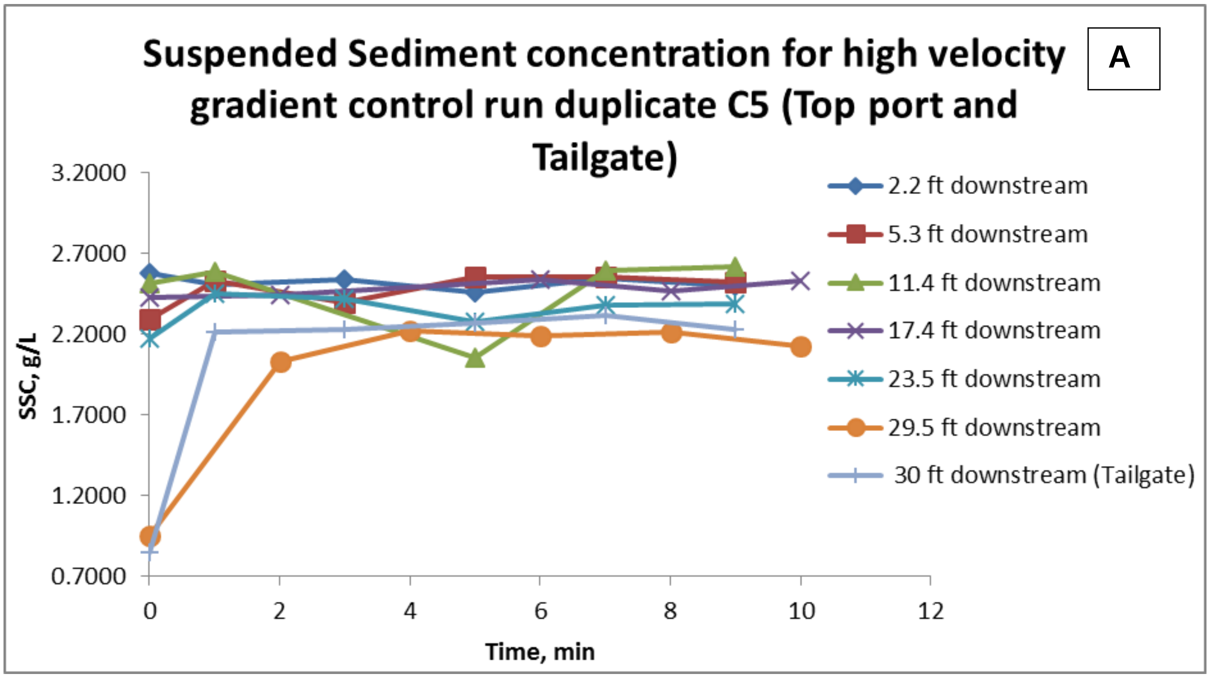
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2229	26.3021	31.4612	26.7938	0.2383	0.4917	0.9532	1.9668
2	31.4000	31.4058	31.9075	31.9857	0.5075	0.5799	2.0300	2.3196
3	26.3180	26.3737	26.8732	26.9775	0.5552	0.6038	2.2208	2.4152
4	31.3824	26.2446	31.9295	26.8500	0.5471	0.6054	2.1884	2.4216
5	31.4427	31.4549	31.9957	32.0470	0.5530	0.5921	2.2120	2.3684
6	31.3535	26.2981	31.8845	26.9074	0.5310	0.6093	2.1240	2.4372

Table 238. Suspended sediment concentration for high velocity gradient control run C5 at tailgate('-' indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3272	26.5400	0.2128	0.8512
2	26.3040	26.8582	0.5542	2.2168
3	26.3085	26.8670	0.5585	2.2340
4	26.3029	26.8710	0.5681	2.2724
5	26.2504	26.8305	0.5801	2.3204
6	26.4226	26.9807	0.5581	2.2324

Table 239. Mass of settled sediments in the trays for high velocity gradient control run C5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.30	411.15	14.85
2	871.45	907.25	35.80
3	867.60	911.35	43.75
4	786.70	833.85	47.15
5	789.60	835.20	45.60
6	830.30	877.85	47.55
7	436.85	477.60	40.75
8	825.75	872.25	46.50
9	826.60	869.15	42.55
10	790.00	820.30	30.30
11	760.05	784.60	24.55



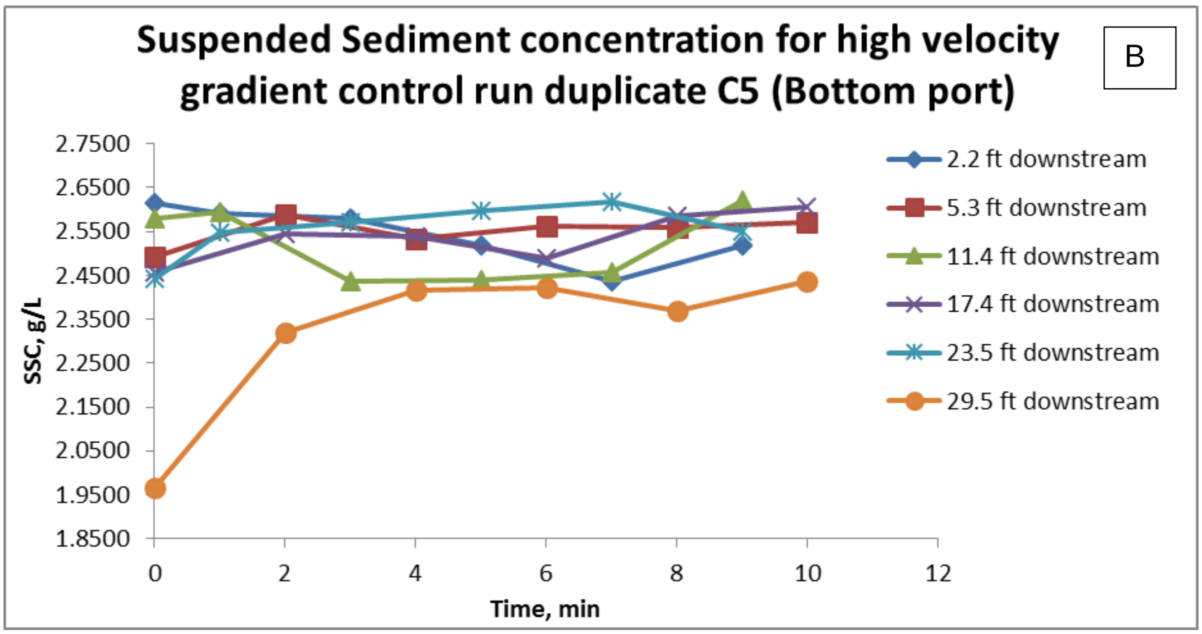


Figure 69. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

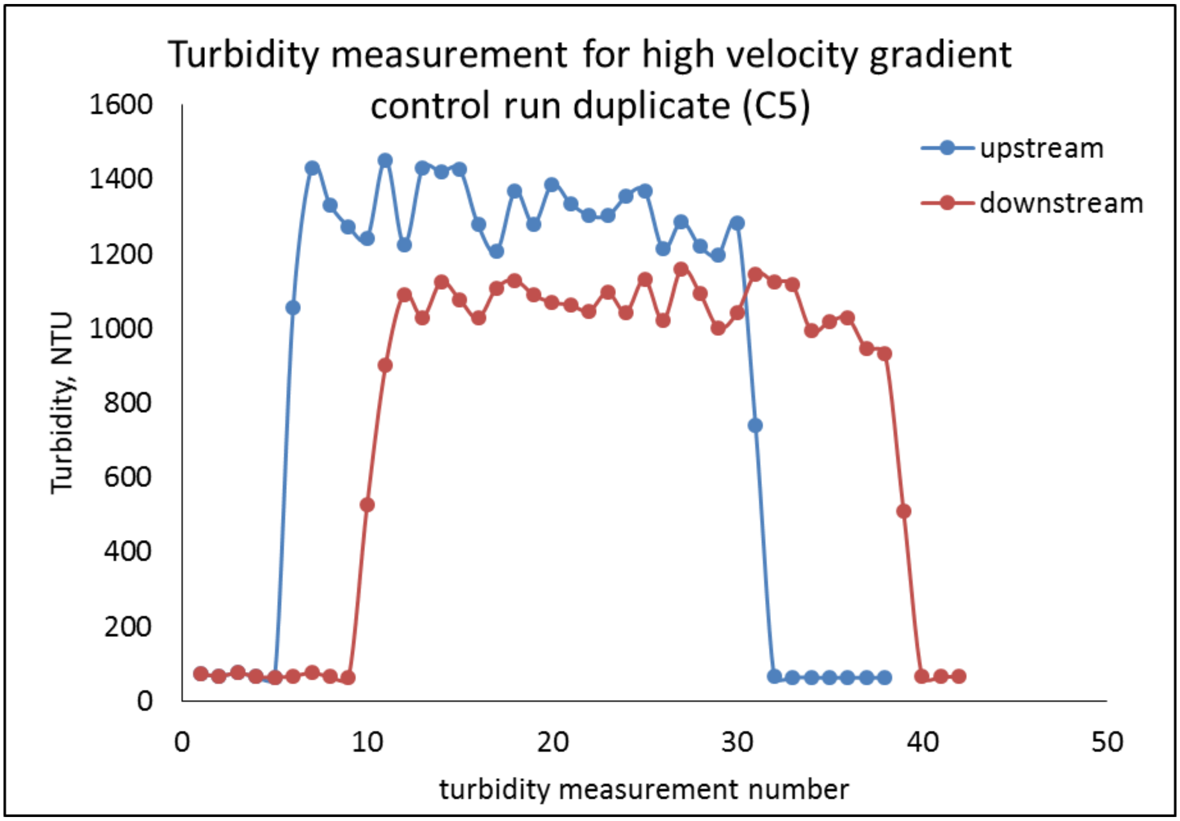


Figure 70. Upstream and downstream turbidity for high velocity gradient control run duplicate C5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Kamie B Control Run Without Agitation Duplicate (C6)</u>

The oscillating grid speed was set at 148 rpm. Tables 240 and 247 show the data related to this run and Figure 71 shows the graph of the sediment concentration. Figure 72 shows the graph of the upstream and downstream turbidity.

Table 240. Suspended sediment concentration for control run without agitation duplicate C6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	31.3522	31.4006	32.0154	32.1059	0.6632	0.7053	2.6528	2.8212
2	31.4566	31.4406	32.1347	32.1363	0.6781	0.6957	2.7124	2.7828
3	31.4423	31.3722	32.1076	32.0661	0.6653	0.6939	2.6612	2.7756
4	26.4085	26.4534	27.1083	27.1819	0.6998	0.7285	2.7992	2.9140
5	26.2504	31.4177	26.9415	32.1413	0.6911	0.7236	2.7644	2.8944
6	26.2793	31.5278	26.9854	32.2571	0.7061	0.7293	2.8244	2.9172

Table 241. Suspended sediment concentration for control run without agitation duplicate C6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	26.4765	26.2353	27.1364	26.9671	0.6599	0.7318	2.6396	2.9272
2	26.4146	26.4298	27.0787	27.1374	0.6641	0.7076	2.6564	2.8304
3	31.4692	26.4348	32.1336	27.2724	0.6644	0.8376	2.6576	3.3504
4	26.3449	31.2240	27.0297	31.9251	0.6848	0.7011	2.7392	2.8044
5	26.2675	26.3981	26.9488	27.1384	0.6813	0.7403	2.7252	2.9612
6	26.3558	26.3003	27.0660	27.0730	0.7102	0.7727	2.8408	3.0908

Table 242. Suspended sediment concentration for control run without agitation duplicate C6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.4862	31.4548	27.1344	32.1402	0.6482	0.6854	2.5928	2.7416
2	26.3900	26.3262	27.0508	27.1402	0.6608	0.8140	2.6432	3.2560
3	31.4617	26.3466	32.1316	27.0750	0.6699	0.7284	2.6796	2.9136
4	26.5006	31.3774	27.1788	32.0692	0.6782	0.6918	2.7128	2.7672
5	26.5313	31.3840	27.0812	32.2365	0.5499	0.8525	2.1996	3.4100
6	31.3602	26.5148	32.0078	27.0855	0.6476	0.5707	2.5904	2.2828

Table 243. Suspended sediment concentration for control run without agitation duplicate C6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	31.4792	26.4856	31.9460	27.1687	0.4668	0.6831	1.8672	2.7324
2	31.4051	31.4440	31.9293	32.1298	0.5242	0.6858	2.0968	2.7432
3	31.4909	31.5069	32.1193	32.1960	0.6284	0.6891	2.5136	2.7564
4	31.3509	31.1903	31.9958	31.8247	0.6449	0.6344	2.5796	2.5376
5	31.4746	26.1823	32.1087	26.8866	0.6341	0.7043	2.5364	2.8172
6	31.4811	31.5413	32.1109	32.2378	0.6298	0.6965	2.5192	2.7860

Table 244. Suspended sediment concentration for control run without agitation C6 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	31.4938	26.3700	32.0346	27.0486	0.5408	0.6786	2.1632	2.7144
2	31.5016	26.3530	32.1191	27.0488	0.6175	0.6958	2.4700	2.7832
3	26.4661	26.4050	27.0432	27.1175	0.5771	0.7125	2.3084	2.8500
4	31.5328	31.4343	32.1579	32.1321	0.6251	0.6978	2.5004	2.7912
5	31.4551	31.3041	31.9999	31.9403	0.5448	0.6362	2.1792	2.5448
6	31.4322	31.4158	32.0525	32.1203	0.6203	0.7045	2.4812	2.8180

Table 245. Suspended sediment concentration for control run without agitation duplicate C6 at Station 6 ('-'indicates No data available).

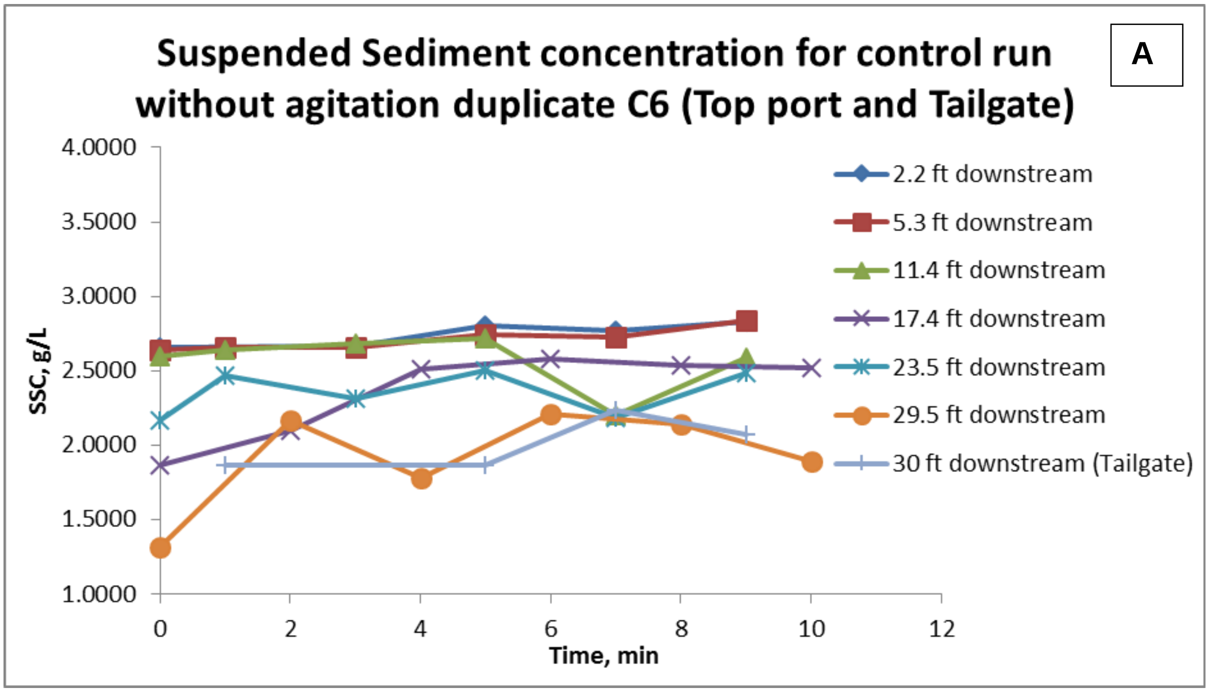
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.2968	31.4581	26.6247	31.9911	0.3279	0.5330	1.3116	2.1320
2	31.4351	26.2548	31.9756	26.9105	0.5405	0.6557	2.1620	2.6228
3	31.5277	26.2576	31.9713	27.2733	0.4436	1.0157	1.7744	4.0628
4	31.4589	26.3764	32.0113	27.1601	0.5524	0.7837	2.2096	3.1348
5	31.4870	26.2907	32.0230	26.9677	0.5360	0.6770	2.1440	2.7080
6	31.3820	26.4526	31.8552	27.1157	0.4732	0.6631	1.8928	2.6524

Table 246. Suspended sediment concentration for control run without agitation duplicate C6 at tailgate ('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3541	26.5576	0.2035	0.8140
2	26.2562	26.7233	0.4671	1.8684
3	26.3412	26.9587	0.6175	2.4700
4	31.5401	32.0053	0.4652	1.8608
5	31.4054	31.9637	0.5583	2.2332
6	26.4042	26.9228	0.5186	2.0744

Table 247. Mass of the sediment settled in the trays for control run without agitation duplicate C6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)
1	393.25	426.80	33.55
2	787.35	849.80	62.45
3	786.95	857.30	70.35
4	792.60	863.80	71.20
5	831.30	900.50	69.20
6	828.75	898.05	69.30
7	434.00	496.35	62.35
8	827.55	891.50	63.95
9	828.65	891.15	62.50
10	829.30	893.15	63.85
11	872.40	933.40	61.00



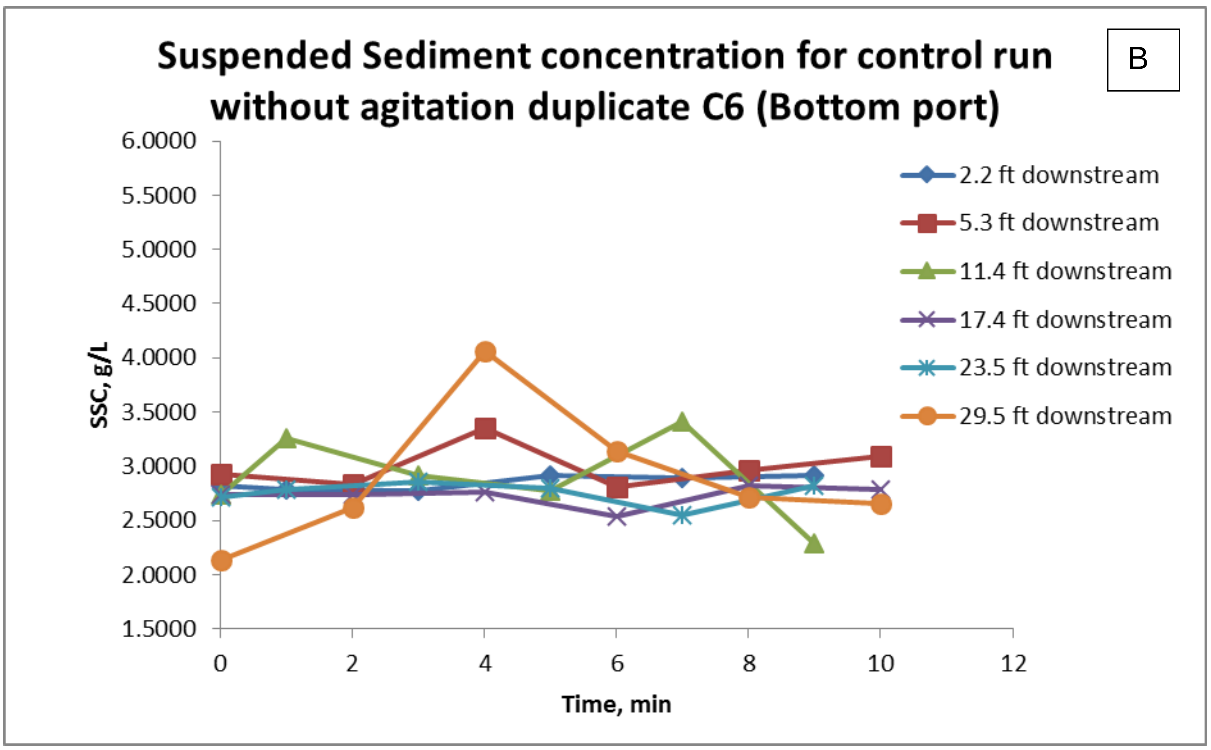


Figure 71. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

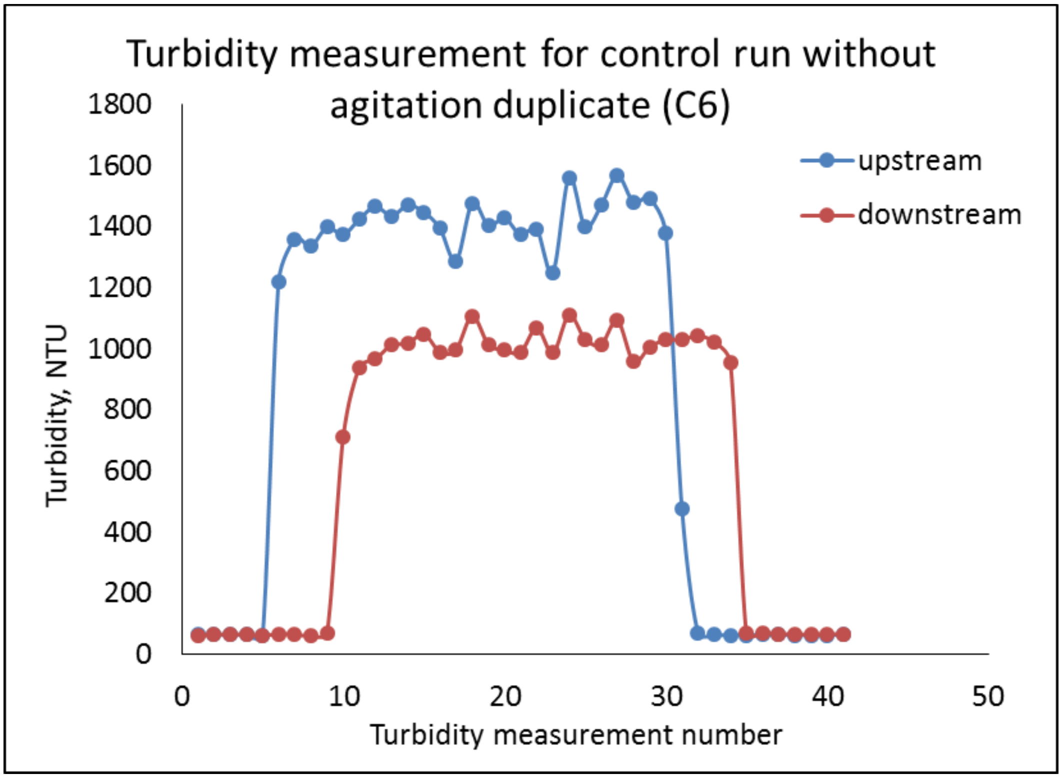


Figure 72. Upstream and downstream turbidity for control run without agitation duplicate C6. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Kamie B Low Velocity Gradient Flocculation Run (F1)</u>

The oscillating grid speed was set at 99 rpm. Tables 248 to 255 show the data related to this run, and Figure 73 shows the graph of the sediment concentration. Figure 74 shows the graph of the upstream and downstream turbidity.

Table 248. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.1088	26.4681	26.7971	26.8376	0.6883	0.3695	2.7532	1.4780
2	26.3538	27.1726	26.7663	27.8347	0.4125	0.6621	1.6500	2.6484
3	26.1379	26.7117	26.9011	26.8592	0.7632	0.1475	3.0528	0.5900
4	26.3296	26.3746	26.7692	26.8270	0.4396	0.4524	1.7584	1.8096
5	26.6519	27.0307	27.0066	27.4693	0.3547	0.4386	1.4188	1.7544
6	26.6666	26.6748	26.8899	26.9495	0.2233	0.2747	0.8932	1.0988

Table 249. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.9019	27.0083	27.3261	27.7661	0.4242	0.7578	1.6968	3.0312
2	26.9956	26.8347	27.2112	27.2357	0.2156	0.4010	0.8624	1.6040
3	26.8792	26.4480	27.0452	26.7681	0.1660	0.3201	0.6640	1.2804
4	27.1769	26.7138	27.4367	27.3133	0.2598	0.5995	1.0392	2.3980
5	26.7342	26.2250	26.9732	26.9083	0.2390	0.6833	0.9560	2.7332
6	26.8820	26.8910	27.0875	27.1957	0.2055	0.3047	0.8220	1.2188

Table 250. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 3 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3383	26.3622	26.7259	26.7460	0.3876	0.3838	1.5504	1.5352
2	26.3329	26.1509	26.7665	26.8850	0.4336	0.7341	1.7344	2.9364
3	26.0790	26.3916	26.8213	26.7561	0.7423	0.3645	2.9692	1.4580
4	26.4400	26.3828	26.7173	26.9010	0.2773	0.5182	1.1092	2.0728
5	27.0010	26.4345	27.4485	26.8832	0.4475	0.4487	1.7900	1.7948
6	26.3202	26.4824	26.7313	26.8843	0.4111	0.4019	1.6444	1.6076

Table 251. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 4 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3991	31.3615	26.8995	31.7312	0.5004	0.3697	2.0016	1.4788
2	26.3940	31.1269	26.8470	31.7795	0.4530	0.6526	1.8120	2.6104
3	26.3338	26.3331	26.6085	26.8112	0.2747	0.4781	1.0988	1.9124
4	26.3937	26.3300	26.4535	26.8635	0.0598	0.5335	0.2392	2.1340
5	26.1320	26.3711	26.5485	26.9564	0.4165	0.5853	1.6660	2.3412
6	26.3933	26.3149	26.7000	26.9798	0.3067	0.6649	1.2268	2.6596

Table 252. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 5 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3248	26.4405	26.7180	26.8738	0.3932	0.4333	1.5728	1.7332
2	31.4610	26.3898	31.7856	26.6577	0.3246	0.2679	1.2984	1.0716
3	26.5956	31.4921	26.7991	31.7411	0.2035	0.2490	0.8140	0.9960
4	26.5759	26.5183	26.6480	26.9402	0.0721	0.4219	0.2884	1.6876
5	26.4946	26.3257	26.6502	26.7052	0.1556	0.3795	0.6224	1.5180
6	26.3316	26.5586	26.5137	26.8470	0.1821	0.2884	0.7284	1.1536

Table 253. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 6 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6958	31.0500	26.7532	31.8780	0.0574	0.8280	0.2296	3.3120
2	26.8920	31.3667	26.9466	31.6825	0.0546	0.3158	0.2184	1.2632
3	26.7797	26.3660	26.9046	26.6051	0.1249	0.2391	0.4996	0.9564
4	26.8828	27.1983	27.0050	27.5338	0.1222	0.3355	0.4888	1.3420
5	26.9621	27.0822	27.1629	27.9134	0.2008	0.8312	0.8032	3.3248
6	26.5205	26.7643	26.6844	27.1857	0.1639	0.4214	0.6556	1.6856

Table 254. Suspended sediment concentration for low velocity gradient flocculation run F1 at tailgate ('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
0	26.3925	26.7214	0.3289	1.3156
1	26.4398	26.5729	0.1331	0.5324
3	31.3355	31.4704	0.1349	0.5396
5	31.2292	31.2980	0.0688	0.2752
7	26.3231	26.5000	0.1769	0.7076
9	26.4955	26.6773	0.1818	0.7272

Table 255. Mass of the sediment settled in the trays for low velocity gradient flocculation run F1.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.15	400.35	4.20
2	759.45	817.40	57.95
3	760.15	790.60	30.45
4	1519.75	1669.45	149.70
5	1520.45	1942.65	422.20
6	2279.70	2768.60	488.90
7	1520.15	1920.65	400.50
8	1520.90	1706.45	185.55
9	1520.20	1619.65	99.45
10	759.40	831.65	72.25
11	759.50	822.90	63.40

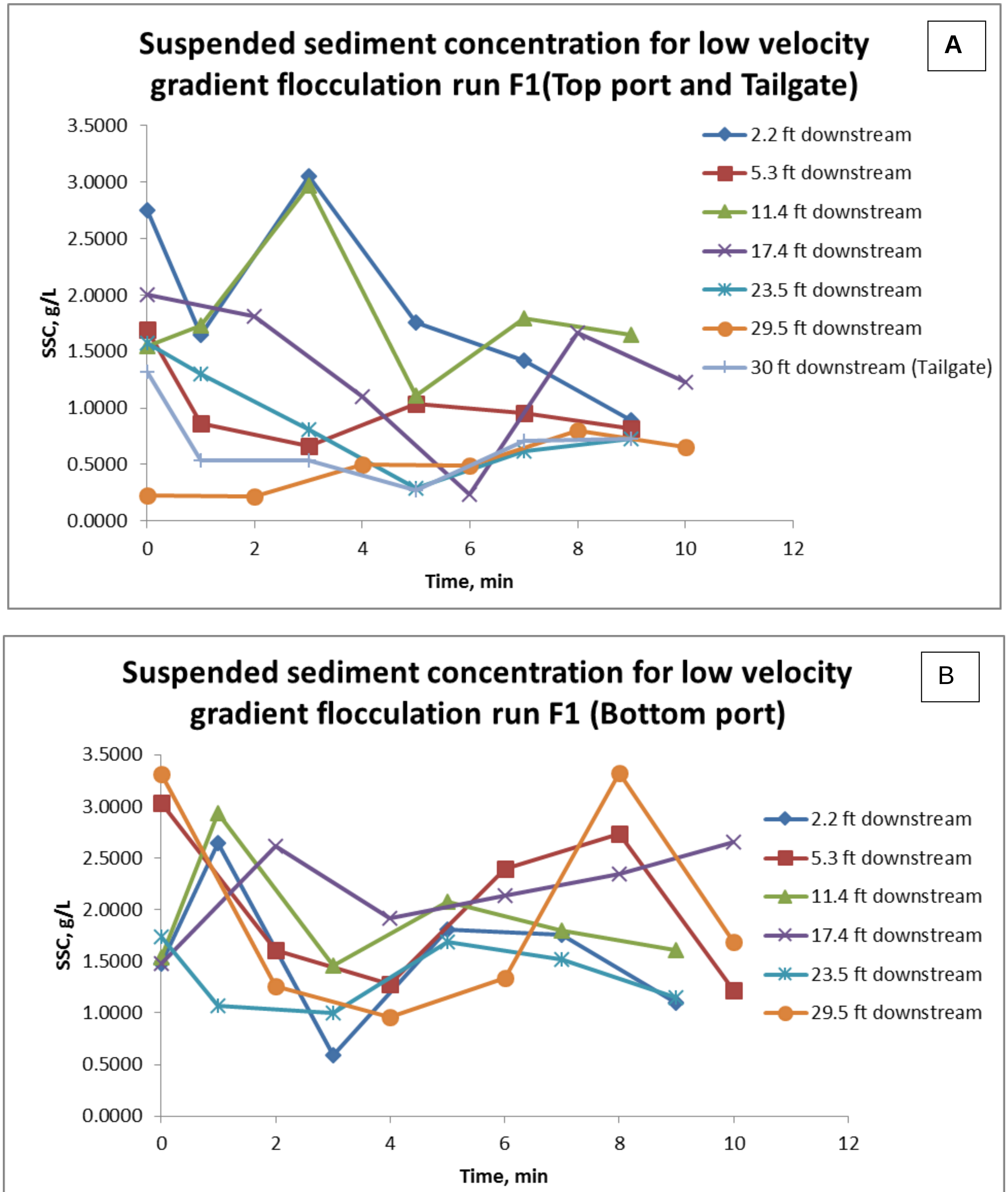


Figure 73. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

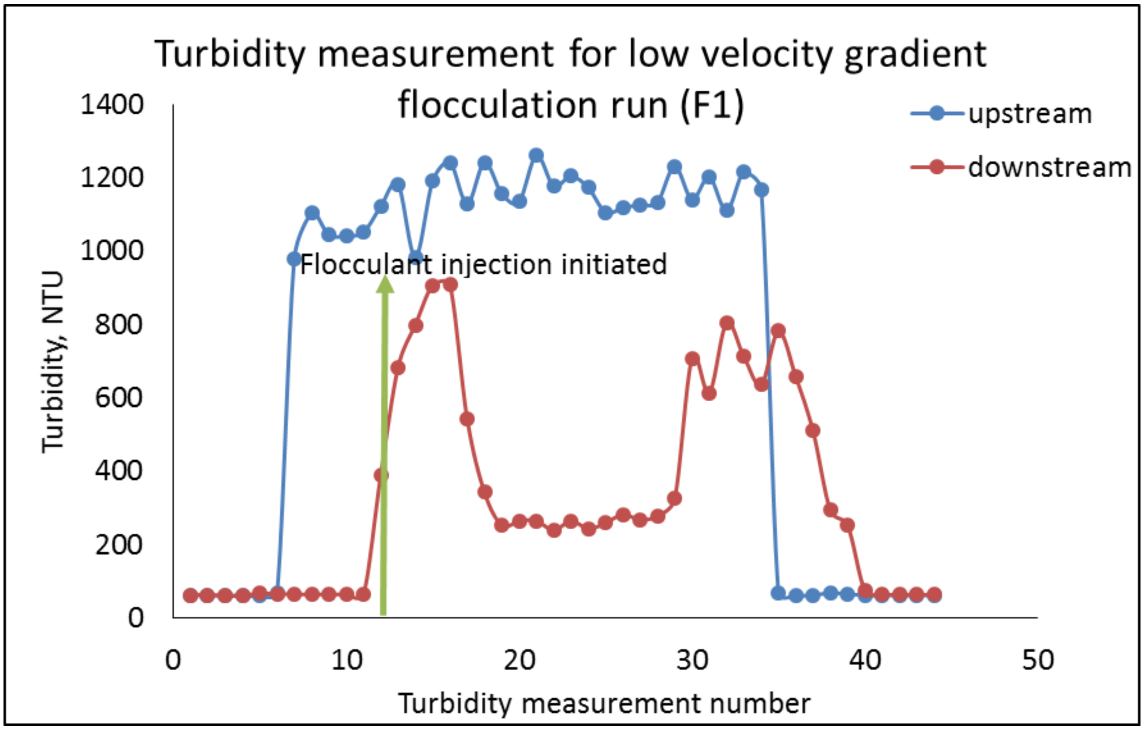


Figure 74. Upstream and downstream turbidity for low velocity gradient flocculation run F1. The turbidity measurement number indicates every 30 second time interval **after which the turbidity reading was recorded by the instrument.**

Kamie B High Velocity Gradient Flocculation Run (F2)

The oscillating grid speed was set at 148 rpm. Tables 256 to 263 show the data related to this run, and Figure 75 shows the graph of the sediment concentration. Figure 76 shows the graph of the upstream and downstream turbidity.

Table 256. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3088	26.4333	26.5682	26.7669	0.2594	0.3336	1.0376	1.3344
2	26.3396	26.3846	26.7650	26.8044	0.4254	0.4198	1.7016	1.6792
3	26.3120	26.2969	26.7535	26.7164	0.4415	0.4195	1.7660	1.6780
4	26.3567	26.2994	26.7684	26.7226	0.4117	0.4232	1.6468	1.6928
5	26.4515	26.4603	26.8924	26.8936	0.4409	0.4333	1.7636	1.7332
6	26.4672	26.3729	26.8747	26.7842	0.4075	0.4113	1.6300	1.6452

Table 257. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4283	26.3516	26.7048	26.8288	0.2765	0.4772	1.1060	1.9088
2	26.2957	26.4716	26.8655	26.7018	0.5698	0.2302	2.2792	0.9208
3	26.3845	26.5389	26.7751	26.9440	0.3906	0.4051	1.5624	1.6204
4	26.2796	26.4380	26.6729	26.8514	0.3933	0.4134	1.5732	1.6536
5	26.4488	26.4629	26.8554	26.8655	0.4066	0.4026	1.6264	1.6104
6	26.5346	26.4480	26.9294	26.8398	0.3948	0.3918	1.5792	1.5672

Table 258. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4407	26.2781	26.8624	26.6891	0.4217	0.4110	1.6868	1.6440
2	26.3371	26.3072	26.6914	26.6942	0.3543	0.3870	1.4172	1.5480
3	26.3318	26.4368	26.7551	26.7962	0.4233	0.3594	1.6932	1.4376
4	26.3696	26.4509	26.7564	26.8487	0.3868	0.3978	1.5472	1.5912
5	26.2985	26.2960	26.6988	26.7115	0.4003	0.4155	1.6012	1.6620
6	26.4162	26.4572	26.8148	26.8716	0.3986	0.4144	1.5944	1.6576

Table 259. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3210	26.4642	26.7386	26.8762	0.4176	0.4120	1.6704	1.6480
2	26.4750	26.3346	26.8096	26.7218	0.3346	0.3872	1.3384	1.5488
3	26.4215	26.2682	26.7591	26.6406	0.3376	0.3724	1.3504	1.4896
4	26.3816	26.3250	26.7142	26.7016	0.3326	0.3766	1.3304	1.5064
5	26.4397	26.3124	26.7768	26.7196	0.3371	0.4072	1.3484	1.6288
6	26.3532	26.3994	26.6855	26.7814	0.3323	0.3820	1.3292	1.5280

Table 260. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4189	26.3147	26.8168	26.7153	0.3979	0.4006	1.5916	6.3664
2	26.3663	26.4917	26.5014	26.6542	0.1351	0.1625	0.5404	2.1616
3	26.3439	26.3198	26.5459	26.6198	0.2020	0.3000	0.8080	3.2320
4	26.4503	26.2700	26.6555	26.5723	0.2052	0.3023	0.8208	3.2832
5	26.2817	26.3825	26.4883	26.6818	0.2066	0.2993	0.8264	3.3056
6	26.4000	26.2957	26.6123	26.5951	0.2123	0.2994	0.8492	3.3968

Table 261. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 6('-'indicates No data available).

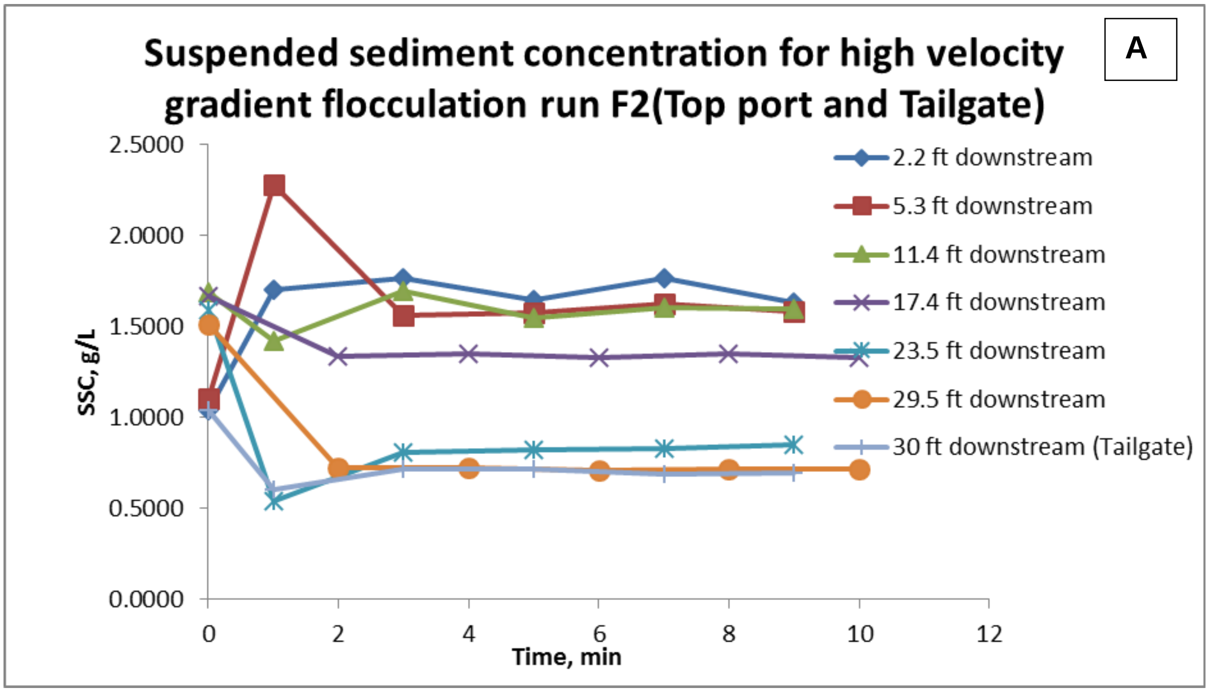
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4743	26.3377	26.8531	26.7188	0.3788	0.3811	1.5152	1.5244
2	26.3444	26.3405	26.5254	26.5753	0.1810	0.2348	0.7240	0.9392
3	26.4246	26.3328	26.6051	26.5605	0.1805	0.2277	0.7220	0.9108
4	26.3062	26.5270	26.4841	26.7524	0.1779	0.2254	0.7116	0.9016
5	26.3271	26.3912	26.5059	26.6200	0.1788	0.2288	0.7152	0.9152
6	26.2900	26.3956	26.4696	26.6253	0.1796	0.2297	0.7184	0.9188

Table 262. Suspended sediment concentration for high velocity gradient flocculation run F2 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3125	26.5726	0.2601	1.0404
2	26.3039	26.4542	0.1503	0.6012
3	26.3565	26.5348	0.1783	0.7132
4	26.3194	26.4980	0.1786	0.7144
5	26.4142	26.5868	0.1726	0.6904
6	26.3167	26.4903	0.1736	0.6944

Table 263. Mass of the sediment settled in the trays for high velocity gradient flocculation run F2

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.15	402.10	5.95
2	759.75	797.80	38.05
3	760.20	793.25	33.05
4	760.25	800.80	40.55
5	1519.30	1588.15	68.85
6	1520.05	1659.00	138.95
7	1518.55	1778.50	259.95
8	1519.55	1913.25	393.70
9	1521.00	1878.40	357.40
10	1519.75	1747.80	228.05
11	1522.10	1671.75	149.65



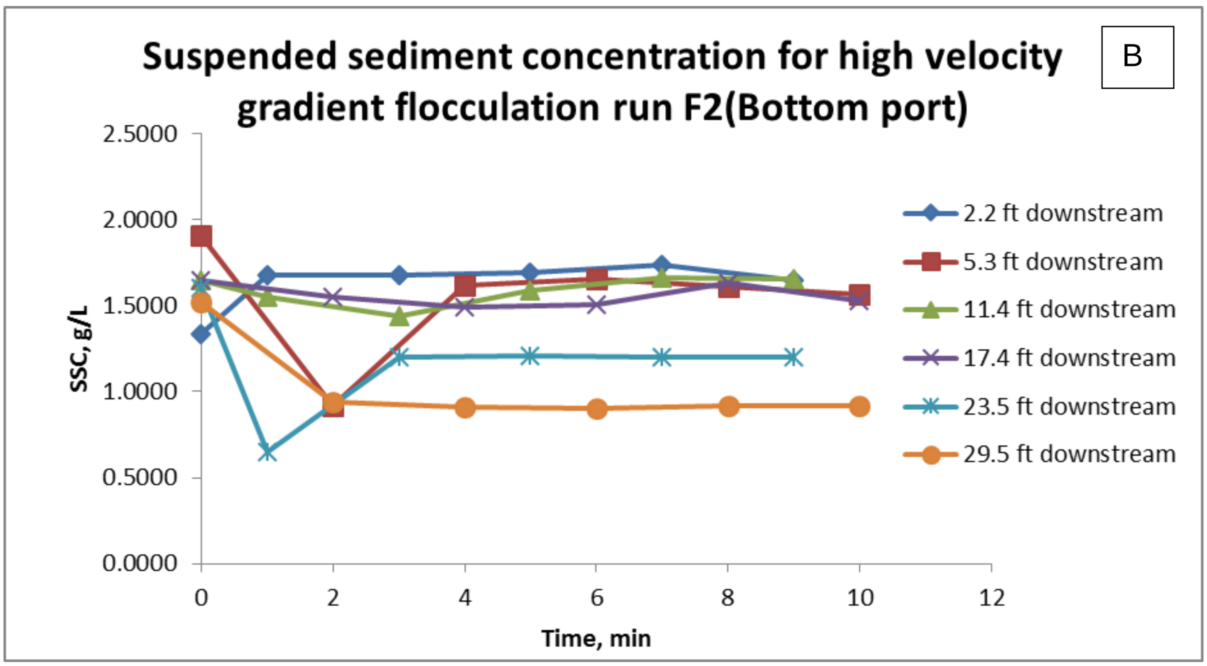


Figure 75. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

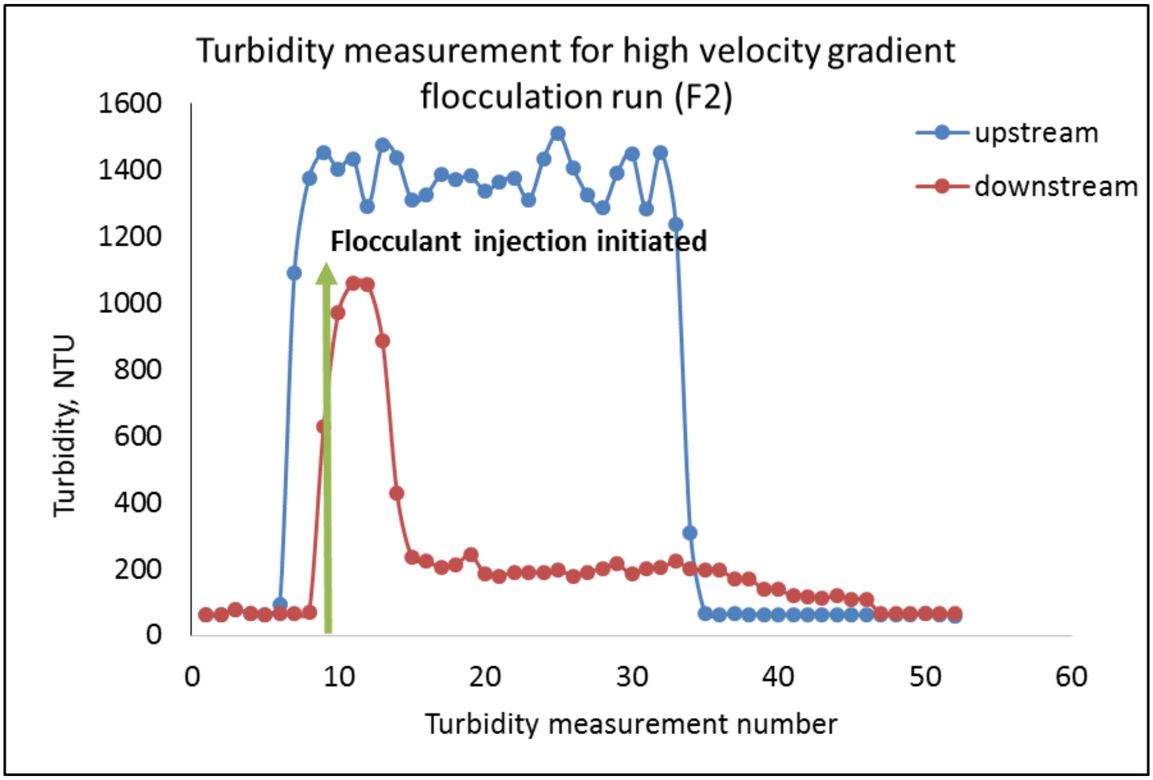


Figure 76. Upstream and downstream turbidity for high velocity gradient flocculation run F2. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

<u>Port B Low Velocity Gradient Flocculation Run Duplicate (F3)</u>

The oscillating grid speed was set at 99 rpm. Tables 264 to 271 show the data related to this run, and Figure 77 shows the graph of the sediment concentration. Figure 78 shows the graph of the upstream and downstream turbidity.

Table 264. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.7293	31.8089	31.9650	31.9504	0.2357	0.1415	0.9428	0.5660
2	26.7766	31.7806	26.9762	31.5989	0.1996	-	0.7984	-
3	31.7920	31.9088	31.9642	31.9721	0.1722	0.0633	0.6888	0.2532
2	31.5831	31.4753	31.7079	31.7785	0.1248	0.3032	0.4992	1.2128
5	26.4271	31.7763	26.7910	31.9553	0.3639	0.1790	1.4556	0.7160
6	26.7407	31.9396	26.9516	31.9405	0.2109	0.0009	0.8436	0.0036

Table 265. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.7251	31.4323	32.0085	31.7027	0.2834	0.2704	1.1336	1.0816
2	31.8873	31.5180	31.9303	-	0.0430	-	0.1720	-
3	31.5806	31.3829	31.8889	31.8094	0.3083	0.4265	1.2332	1.7060
2	26.7785	31.5891	26.9669	31.7363	0.1884	0.1472	0.7536	0.5888
5	26.6034	31.5944	26.8584	31.7908	0.2550	0.1964	1.0200	0.7856
6	31.5585	31.6770	31.8018	31.9391	0.2433	0.2621	0.9732	1.0484

Table 266. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6586	31.5124	26.9274	31.9731	0.2688	0.4607	1.0752	1.8428
2	31.8444	31.7402	32.1762	31.9425	0.3318	0.2023	1.3272	0.8092
3	26.6223	31.7262	26.9161	31.7369	0.2938	0.0107	1.1752	0.0428
2	31.8220	31.6702	32.3419	31.8266	0.5199	0.1564	2.0796	0.6256
5	31.9091	26.4285	32.1862	27.6379	0.2771	1.2094	1.1084	4.8376
6	26.7719	31.6946	26.8637	32.6442	0.0918	0.9496	0.3672	3.7984

Table 267. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6269	26.6497	26.8639	26.8874	0.2370	0.2377	0.9480	0.9508
2	26.6980	31.5915	26.7463	31.7455	0.0483	0.1540	0.1932	0.6160
3	26.6987	31.7000	26.8555	31.8676	0.1568	0.1676	0.6272	0.6704
2	31.7326	31.5845	31.7959	31.9451	0.0633	0.3606	0.2532	1.4424
5	31.5410	31.7110	31.6365	31.8166	0.0955	0.1056	0.3820	0.4224
6	31.7501	31.5630	31.8698	31.8478	0.1197	0.2848	0.4788	1.1392

Table 268. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.9186	26.7359	31.9596	27.1185	0.0410	0.3826	0.1640	1.5304
2	31.4827	31.7540	31.7026	32.1647	0.2199	0.4107	0.8796	1.6428
3	26.8529	31.8420	27.0074	32.2797	0.1545	0.4377	0.6180	1.7508
2	31.7940	26.6717	32.2270	26.9556	0.4330	0.2839	1.7320	1.1356
5	31.6735	31.7185	31.9808	32.0922	0.3073	0.3737	1.2292	1.4948
6	31.7312	31.6703	31.8226	31.9141	0.0914	0.2438	0.3656	0.9752

Table 269. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 6('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6099	26.7200	26.7650	26.8231	0.1551	0.1031	0.6204	0.4124
2	31.7234	31.5848	31.8276	31.6403	0.1042	0.0555	0.4168	0.2220
3	26.6345	26.6301	26.6450	26.7121	0.0105	0.0820	0.0420	0.3280
2	26.6177	26.5694	26.6934	26.6417	0.0757	0.0723	0.3028	0.2892
5	26.6731	31.7638	26.7714	31.8017	0.0983	0.0379	0.3932	0.1516
6	26.3817	31.7075	26.4245	31.7319	0.0428	0.0244	0.1712	0.0976

Table 270. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at tailgate(‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.4836	26.6015	0.1179	0.4716
2	26.8531	26.9175	0.0644	0.2576
3	26.4353	26.4934	0.0581	0.2324
2	26.6653	26.6697	0.0044	0.0176
5	27.1738	27.3851	0.2113	0.8452
6	26.8248	26.8527	0.0279	0.1116

Table 271. Mass of the sediment settled in the trays for low velocity gradient flocculation run duplicate F3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)
1	73.75	89.60	15.85
2	73.85	130.20	56.35
3	140.60	296.60	156.00
4	143.15	676.35	533.20
5	140.65	863.65	723.00
6	143.80	899.80	756.00
7	143.25	693.75	550.50
8	146.95	442.30	295.35
9	139.70	249.25	109.55
10	69.20	136.15	66.95
11	72.45	124.70	52.25

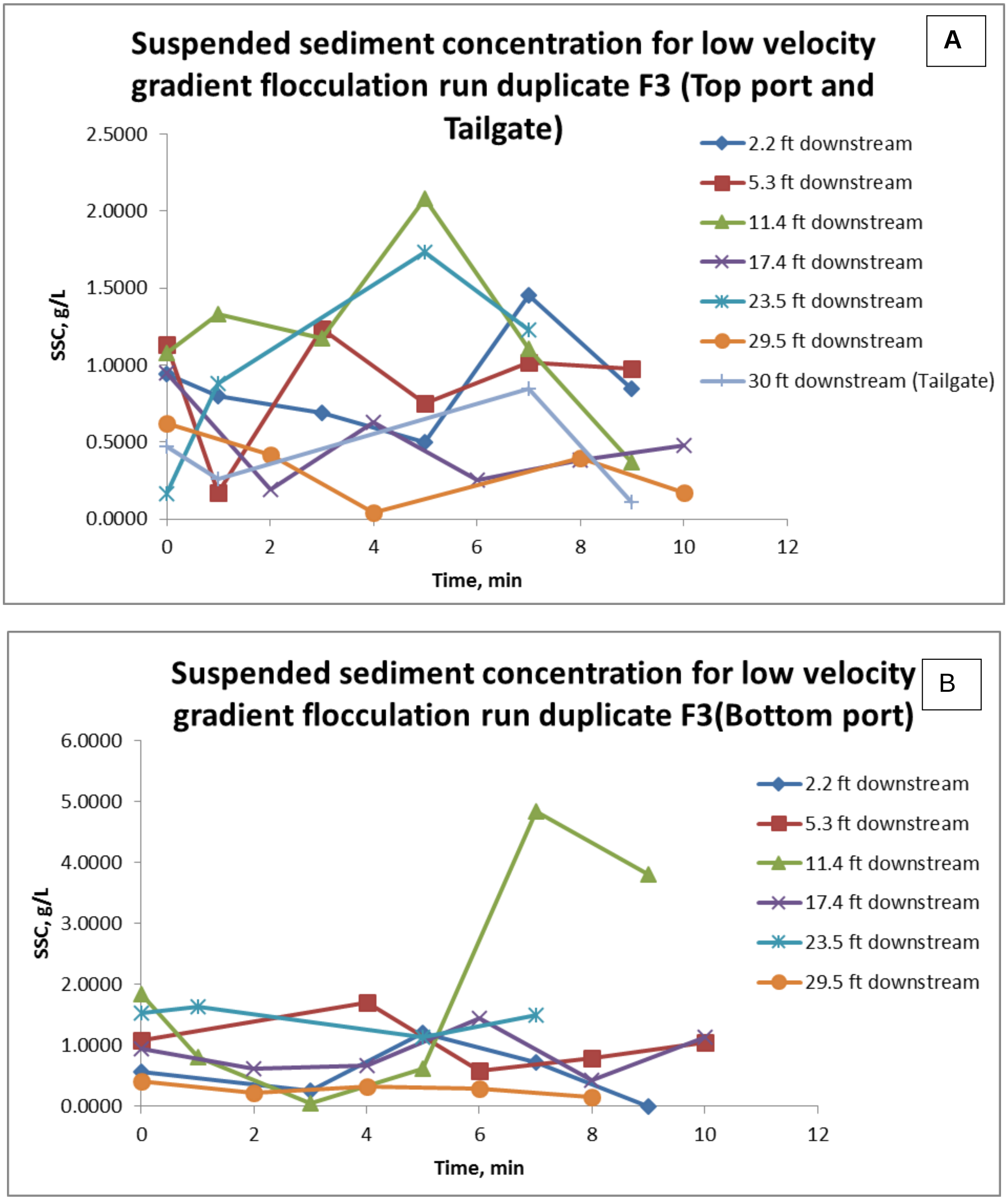


Figure 77. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

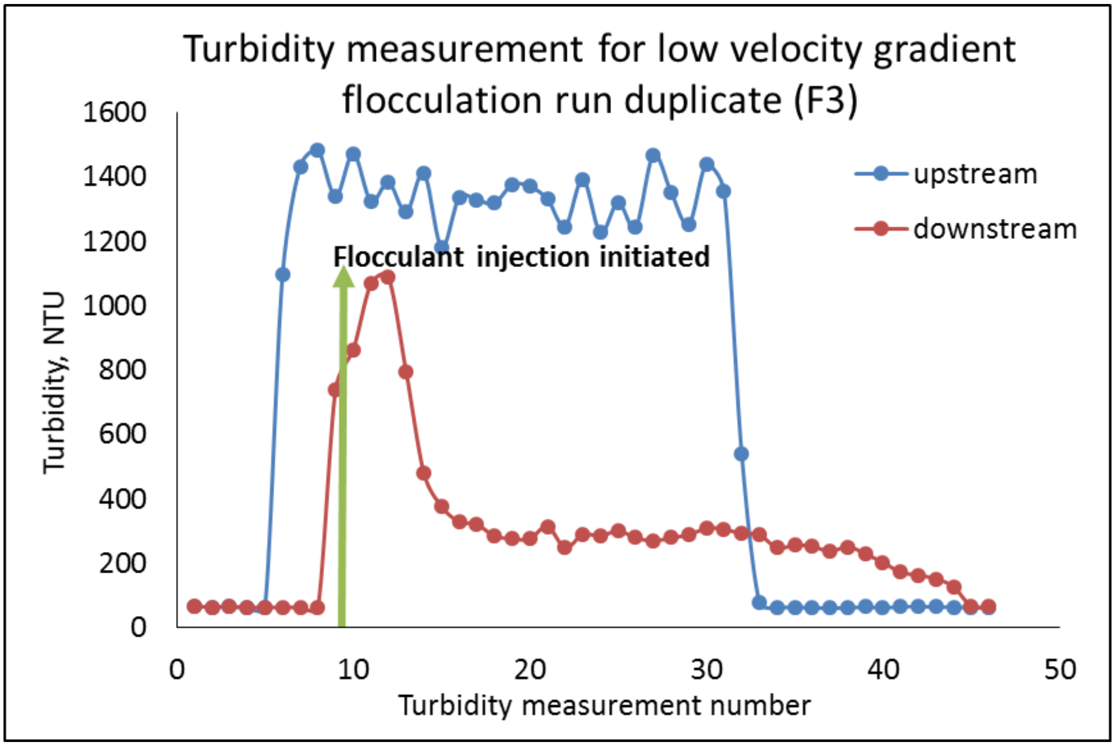


Figure 78. Upstream and downstream turbidity for low velocity gradient flocculation run duplicate F3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>High Velocity Gradient Flocculation Run Duplicate (F4)</u>

The oscillating grid speed was set at 148 rpm. Tables 272 to 279 show the data related to this run, and Figure 79 shows the graph of the sediment concentration. Figure 80 shows the graph of the upstream and downstream turbidity.

Table 272. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 1(‘-‘indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3199	26.4106	26.9395	27.0741	0.6196	0.6635	2.4784	2.6540
2	26.3827	26.4300	27.0189	27.0905	0.6362	0.6605	2.5448	2.6420
3	26.4007	26.3001	27.0637	27.0201	0.6630	0.7200	2.6520	2.8800
4	26.3736	26.5552	27.0130	27.0668	0.6394	0.5116	2.5576	2.0464
5	26.3394	26.4251	26.9167	27.0870	0.5773	0.6619	2.3092	2.6476
6	26.3019	26.4441	26.9454	27.1245	0.6435	0.6804	2.5740	2.7216

Table 273. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 2(‘-‘indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5829	26.4382	27.1241	27.0560	0.5412	0.6178	2.1648	2.4712
2	26.4213	26.4320	27.0421	27.0897	0.6208	0.6577	2.4832	2.6308
3	26.2701	26.3894	26.9134	27.0509	0.6433	0.6615	2.5732	2.6460
4	26.3357	26.2514	26.9262	26.9056	0.5905	0.6542	2.3620	2.6168
5	26.4008	26.4045	27.0633	27.0393	0.6625	0.6348	2.6500	2.5392
6	26.5131	26.4524	26.9879	27.0808	0.4748	0.6284	1.8992	2.5136

Table 274. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 3('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4309	26.2965	26.8005	26.9598	0.3696	0.6633	1.4784	2.6532
2	26.4926	26.3208	26.6353	26.9075	0.1427	0.5867	0.5708	2.3468
3	26.3566	26.3296	26.5651	27.2271	0.2085	0.8975	0.8340	3.5900
4	26.5873	26.4326	26.6953	28.4799	0.1080	2.0473	0.4320	8.1892
5	26.4344	26.4570	26.7144	29.8849	0.2800	3.4279	1.1200	13.7116
6	26.3674	26.4742	26.6408	28.7550	0.2734	2.2808	1.0936	9.1232

Table 275. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 4('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4205	26.4599	27.0200	27.0710	0.5995	0.6111	2.3980	2.4444
2	26.3441	26.4078	26.4257	26.6550	0.0816	0.2472	0.3264	0.9888
3	26.5846	26.4765	26.6172	26.7084	0.0326	0.2319	0.1304	0.9276
4	26.2506	26.3733	26.4075	26.5453	0.1569	0.1720	0.6276	0.6880
5	26.4873	26.5717	26.5990	26.7792	0.1117	0.2075	0.4468	0.8300
6	26.4327	26.5536	26.5738	26.6741	0.1411	0.1205	0.5644	0.4820

Table 276. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 5('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4099	26.4372	26.9754	27.0382	0.5655	0.6010	2.2620	9.0480
2	26.3485	26.4160	26.4929	26.8993	0.1444	0.4833	0.5776	2.3104
3	26.4420	31.3219	26.5015	31.5005	0.0595	0.1786	0.2380	0.9520
4	31.2423	26.3376	31.3534	26.4893	0.1111	0.1517	0.4444	1.7776
5	26.2683	26.2236	26.4216	26.4218	0.1533	0.1982	0.6132	2.4528
6	31.3987	31.4923	31.5329	31.6684	0.1342	0.1761	0.5368	2.1472

Table 277. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 6('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5460	26.4403	26.9844	26.9154	0.4384	0.4751	1.7536	1.9004
2	26.3150	26.4544	26.4278	26.8285	0.1128	0.3741	0.4512	1.4964
3	31.3711	26.4590	31.4980	26.4930	0.1269	0.0340	0.5076	0.1360
4	26.5061	26.5283	26.6616	26.6273	0.1555	0.0990	0.6220	0.3960
5	26.3498	26.4501	26.4737	26.4971	0.1239	0.0470	0.4956	0.1880
6	31.4426	26.4828	31.5188	26.6195	0.0762	0.1367	0.3048	0.5468

Table 278. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at tailgate('-'indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
0	26.4282	26.7312	0.3030	1.2120
1	26.3979	26.9002	0.5023	2.0092
3	26.4639	26.5399	0.0760	0.3040
5	26.3926	26.4948	0.1022	0.4088
7	26.3426	26.4894	0.1468	0.5872
9	26.4011	26.5152	0.1141	0.4564

Table 279. Mass of the sediment settled in the trays for high velocity gradient flocculation run duplicate F4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.40	407.10	10.70
2	760.30	886.80	126.50
3	1519.30	2031.45	512.15
4	1595.60	2341.85	746.25
5	2280.35	3275.30	994.95
6	2279.70	3113.70	834.00
7	1520.35	1746.95	226.60
8	1521.00	1682.00	161.00
9	1519.60	1647.15	127.55
10	1520.15	1610.05	89.90
11	1519.40	1596.65	77.25

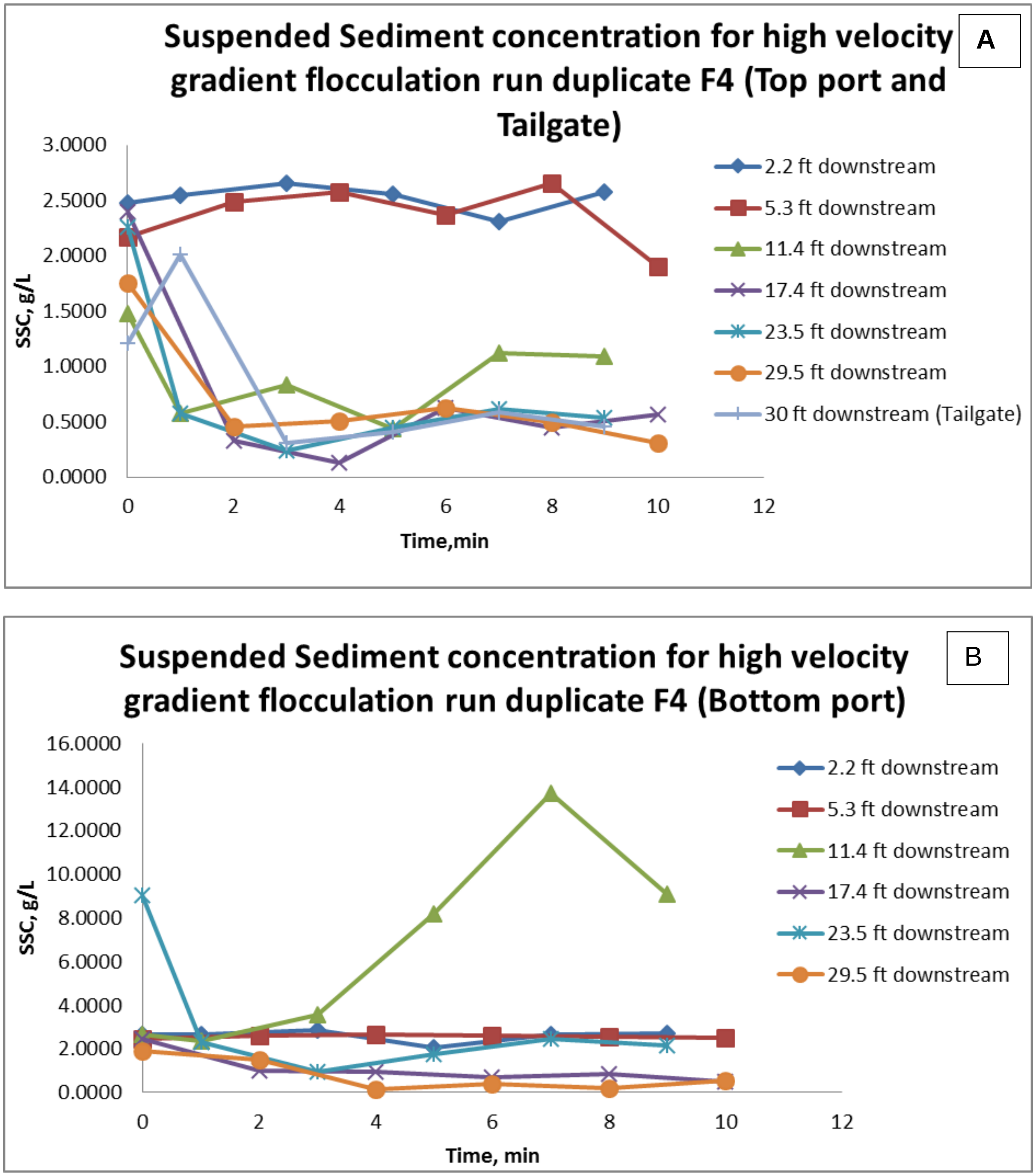


Figure 79: **Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.**

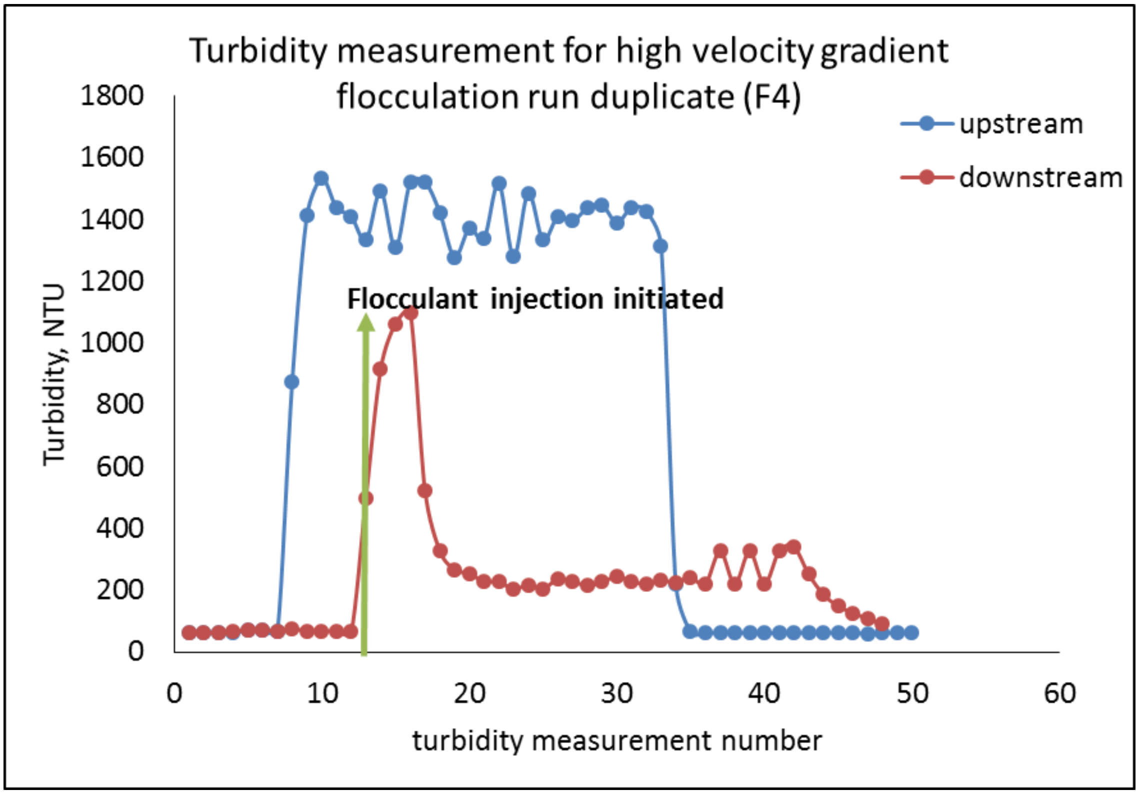


Figure 80. Upstream and downstream turbidity for high velocity gradient flocculation run duplicate F4. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument

Port B Low Velocity Gradient Flocculation Run Triplicate (F5)

The oscillating grid speed was set at 99 rpm. Tables 280 to 287 show the data related to this run, and Figure 81 shows the graph of the sediment concentration. Figure 82 shows the graph of the upstream and downstream turbidity.

Table 280: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4095	26.2204	27.0212	26.8356	0.6117	0.6152	2.4468	2.4608
2	26.2474	26.4556	26.8752	27.1143	0.6278	0.6587	2.5112	2.6348
3	26.2918	26.3967	26.9331	26.9972	0.6413	0.6005	2.5652	2.4020
4	26.3944	26.3491	27.0146	27.0310	0.6202	0.6819	2.4808	2.7276
5	26.2550	26.4228	26.8795	27.0809	0.6245	0.6581	2.4980	2.6324
6	26.3099	26.4434	26.9406	27.1122	0.6307	0.6688	2.5228	2.6752

Table 281: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2379	26.2838	26.8417	26.8984	0.6038	0.6146	2.4152	2.4584
2	26.3149	26.4733	26.9286	27.1028	0.6137	0.6295	2.4548	2.5180
3	26.2693	31.4160	26.8817	32.0414	0.6124	0.6254	2.4496	2.5016
4	26.4079	26.3595	26.8875	26.9942	0.4796	0.6347	1.9184	2.5388
5	26.2818	26.3501	27.0326	27.0264	0.7508	0.6763	3.0032	2.7052
6	26.3692	26.4677	27.0128	27.1364	0.6436	0.6687	2.5744	2.6748

Table 282: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3826	26.2247	26.9853	26.8790	0.6027	0.6543	2.4108	2.6172
2	26.1983	26.2696	26.4232	26.9606	0.2249	0.6910	0.8996	2.7640
3	26.3997	26.2203	26.6660	26.8687	0.2663	0.6484	1.0652	2.5936
4	26.2533	26.3912	26.5320	27.6853	0.2787	1.2941	1.1148	5.1764
5	26.2558	26.2984	26.9653	27.7335	0.7095	1.4351	2.8380	5.7404
6	26.3849	26.3028	26.7335	27.7540	0.3486	1.4512	1.3944	5.8048

Table 283: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4278	31.4519	27.0611	32.1089	0.6333	0.6570	2.5332	2.6280
2	26.2719	26.3757	26.4251	26.6525	0.1532	0.2768	0.6128	1.1072
3	26.4651	26.2630	26.6128	26.5705	0.1477	0.3075	0.5908	1.2300
4	26.2574	26.3973	26.4256	26.7116	0.1682	0.3143	0.6728	1.2572
5	26.2505	26.4857	26.4249	26.8113	0.1744	0.3256	0.6976	1.3024
6	26.2693	26.4801	26.5289	26.9376	0.2596	0.4575	1.0384	1.8300

Table 284: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4750	26.3153	27.0754	26.9781	0.6004	0.6628	2.4016	2.6512
2	26.2477	26.2681	26.5540	26.8936	0.3063	0.6255	1.2252	2.5020
3	26.2928	26.4109	26.4277	26.6405	0.1349	0.2296	0.5396	0.9184
4	26.2796	26.3861	26.4232	26.6412	0.1436	0.2551	0.5744	1.0204
5	26.5029	26.2614	26.6661	26.5047	0.1632	0.2433	0.6528	0.9732
6	26.3888	26.4963	26.5427	26.7233	0.1539	0.2270	0.6156	0.9080

Table 285: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 6('-'indicates No data available).

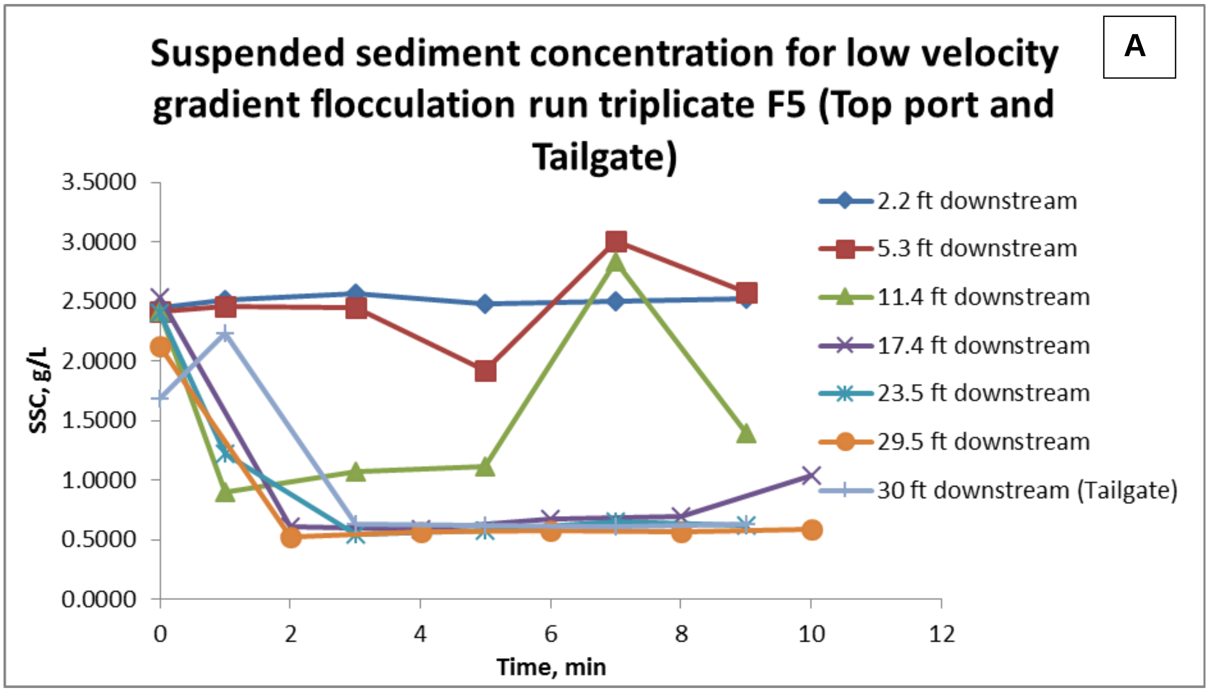
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3019	26.3213	26.8336	26.9466	0.5317	0.6253	2.1268	2.5012
2	26.3455	26.3502	26.4753	26.7687	0.1298	0.4185	0.5192	1.6740
3	26.3209	26.3780	26.4622	26.5721	0.1413	0.1941	0.5652	0.7764
4	26.2818	26.4350	26.4263	26.6484	0.1445	0.2134	0.5780	0.8536
5	26.2539	26.4489	26.3951	26.6589	0.1412	0.2100	0.5648	0.8400
6	26.2487	26.3008	26.3953	26.5114	0.1466	0.2106	0.5864	0.8424

Table 286: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at tailgate (‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.4360	26.8572	0.4212	1.6848
2	26.5186	27.0773	0.5587	2.2348
3	26.2474	26.4061	0.1587	0.6348
4	26.2919	26.4469	0.1550	0.6200
5	26.4768	26.6283	0.1515	0.6060
6	26.2882	26.4452	0.1570	0.6280

Table 287: Mass of the sediment settled in the trays for low velocity gradient flocculation run triplicate F5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	69.45	88.10	18.65
2	71.55	144.80	73.25
3	140.00	366.75	226.75
4	208.55	826.00	617.45
5	213.75	1027.75	814.00
6	150.15	811.10	660.95
7	136.98	584.10	447.12
8	145.70	411.80	266.10
9	145.92	244.50	98.58
10	149.00	223.40	74.40
11	75.62	134.20	58.58



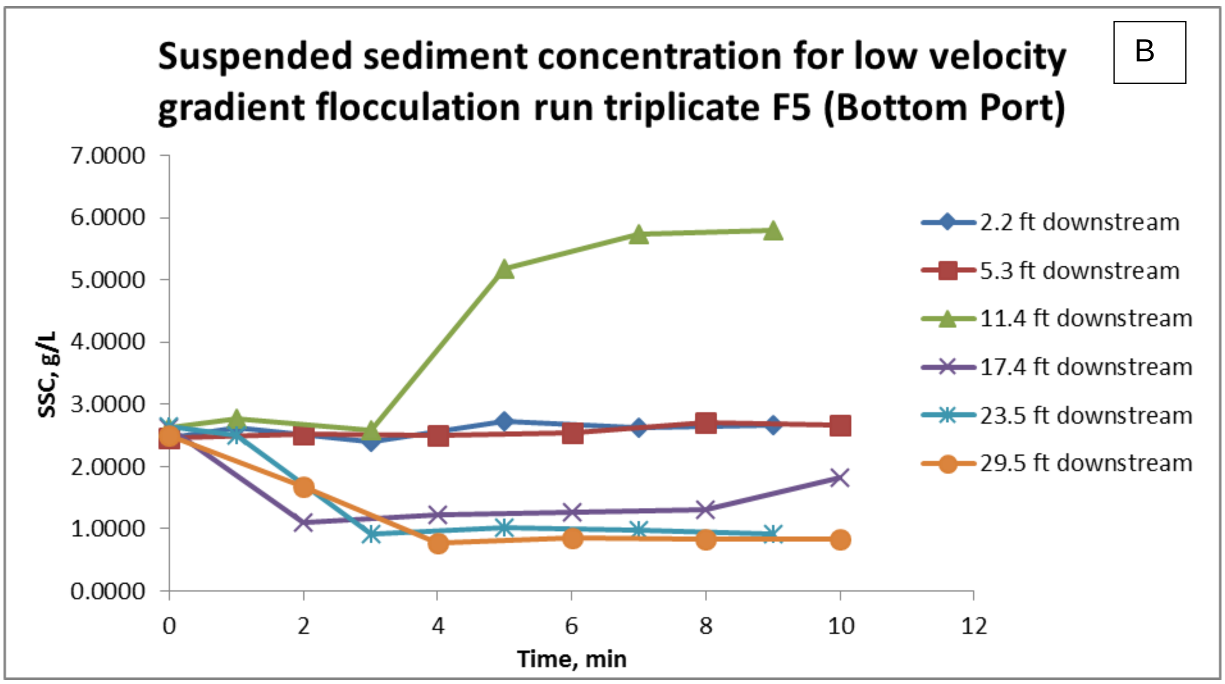


Figure 81: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

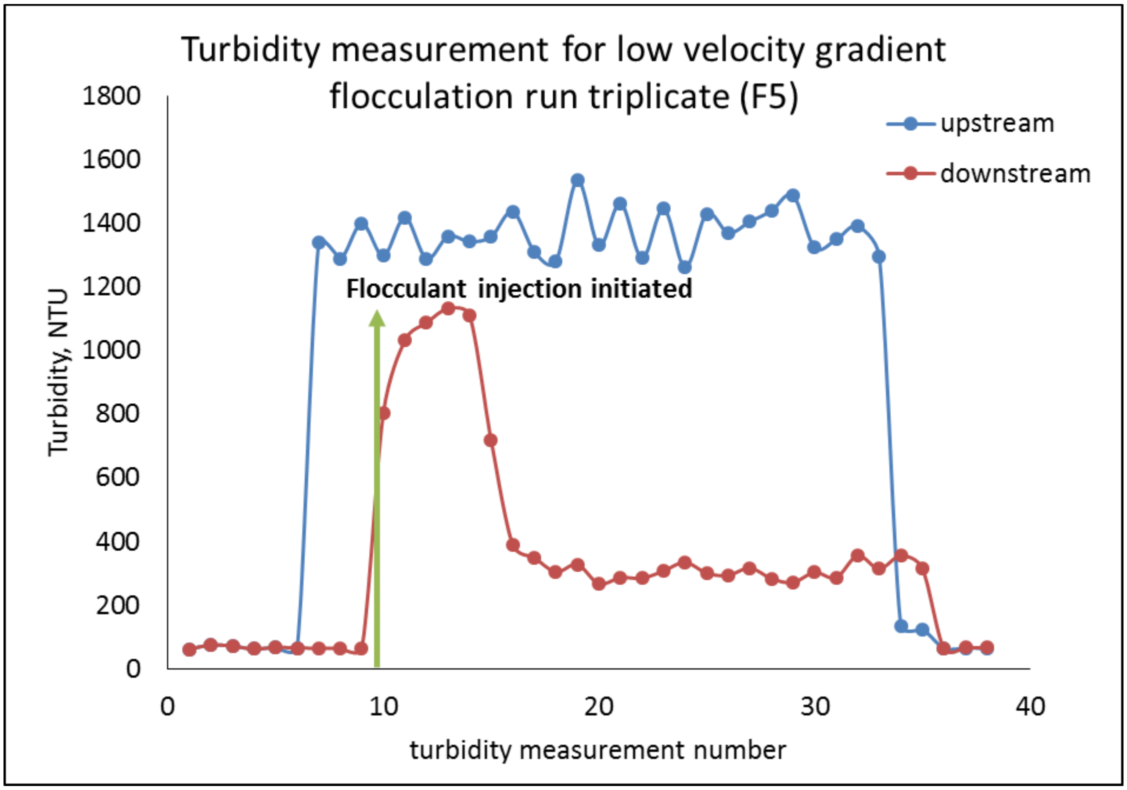


Figure 82. Upstream and downstream turbidity for low velocity gradient flocculation run triplicate F5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Kamie B High Velocity Gradient Flocculation Run Triplicate (F6)</u>

The oscillating grid speed was set at 148 rpm. Tables 288 to 295 show the data related to this run, and Figure 83 shows the graph of the sediment concentration. Figure 84 shows the graph of the upstream and downstream turbidity. Figure 85 below summarizes the trapping efficiencies for the Kamie B soil and Table 296 shows the values of the stickiness coefficient obtained.

Table 288. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4229	31.2105	27.1351	31.9655	0.7122	0.7550	2.8488	3.0200
2	31.3314	26.3134	32.0700	27.1143	0.7386	0.8009	2.9544	3.2036
3	26.1698	26.3443	26.9203	27.0581	0.7505	0.7138	3.0020	2.8552
4	31.4233	26.4450	32.1453	27.1896	0.7220	0.7446	2.8880	2.9784
5	26.2799	26.2921	27.0196	27.0232	0.7397	0.7311	2.9588	2.9244
6	31.3817	26.3190	32.0912	27.0849	0.7095	0.7659	2.8380	3.0636

Table 289. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2681	26.5160	26.9551	27.2281	0.6870	0.7121	2.7480	2.8484
2	31.1444	26.4945	31.8662	27.2456	0.7218	0.7511	2.8872	3.0044
3	26.4813	31.2285	27.1904	31.9358	0.7091	0.7073	2.8364	2.8292
4	26.4219	26.4843	27.1492	27.2332	0.7273	0.7489	2.9092	2.9956
5	31.4870	31.4390	32.1875	32.1677	0.7005	0.7287	2.8020	2.9148
6	31.4730	31.1439	32.1692	31.8685	0.6962	0.7246	2.7848	2.8984

Table 290. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5171	26.4610	26.9396	27.1823	0.4225	0.7213	1.6900	2.8852
2	26.3960	26.2822	26.6021	26.9233	0.2061	0.6411	0.8244	2.5644
3	31.3732	26.3272	31.5965	27.9647	0.2233	1.6375	0.8932	6.5500
4	26.4220	26.2735	26.6825	29.9112	0.2605	3.6377	1.0420	14.5508
5	26.3100	26.3345	26.5701	28.1490	0.2601	1.8145	1.0404	7.2580
6	26.3868	26.3448	26.6940	29.2335	0.3072	2.8887	1.2288	11.5548

Table 291. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4988	31.4689	27.1303	32.2170	0.6315	0.7481	2.5260	2.9924
2	26.2541	26.2334	26.3975	26.5290	0.1434	0.2956	0.5736	1.1824
3	26.3042	26.3875	26.4769	26.6480	0.1727	0.2605	0.6908	1.0420
4	31.4423	26.4426	31.6043	26.7018	0.1620	0.2592	0.6480	1.0368
5	26.2610	31.3714	26.4367	31.6367	0.1757	0.2653	0.7028	1.0612
6	31.3802	26.2756	31.5484	26.5569	0.1682	0.2813	0.6728	1.1252

Table 292. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3750	31.2188	27.0033	31.9197	0.6283	0.7009	2.5132	2.8036
2	26.2757	26.2503	26.4601	26.8469	0.1844	0.5966	0.7376	2.3864
3	31.3849	31.2250	31.5068	31.3941	0.1219	0.1691	0.4876	0.6764
4	31.5884	31.3849	31.6601	31.5703	0.0717	0.1854	0.2868	0.7416
5	31.4456	31.5192	31.5730	31.7037	0.1274	0.1845	0.5096	0.7380
6	26.4355	26.2726	26.5804	26.4699	0.1449	0.1973	0.5796	0.7892

Table 293. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 6('-'indicates No data available).

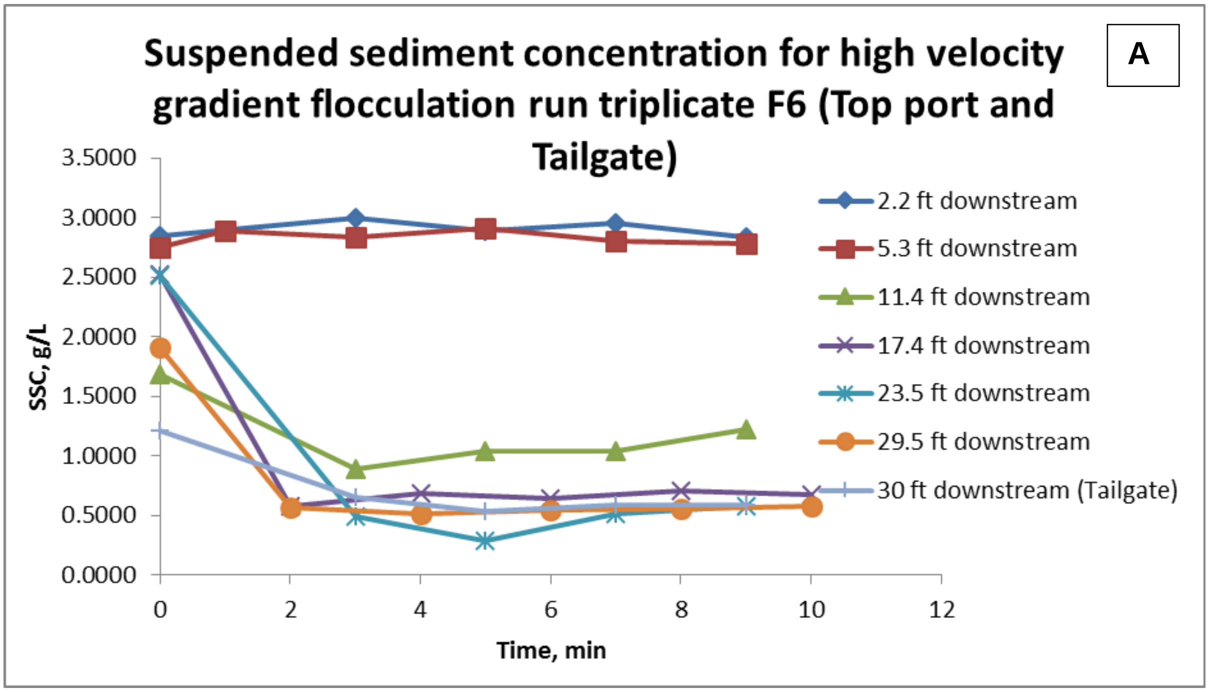
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2659	26.4820	26.7451	27.1758	0.4792	0.6938	1.9168	2.7752
2	31.4098	26.3192	31.5512	26.6654	0.1414	0.3462	0.5656	1.3848
3	31.3700	31.2289	31.4976	31.3986	0.1276	0.1697	0.5104	0.6788
4	31.3800	31.4901	31.5153	31.6507	0.1353	0.1606	0.5412	0.6424
5	26.4351	31.3995	26.5734	31.5451	0.1383	0.1456	0.5532	0.5824
6	26.4153	31.3706	26.5587	31.5955	0.1434	0.2249	0.5736	0.8998

Table 294. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	31.3675	31.6697	0.3022	1.2088
2	26.4074	26.9183	-	-
3	26.2809	26.4437	0.1628	0.6512
4	31.4712	31.6044	0.1332	0.5328
5	31.1412	31.2884	0.1472	0.5888
6	26.2794	26.4279	0.1485	0.5940

Table 295. Mass of the sediment settled in the trays for high velocity gradient flocculation run triplicate F6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	396.30	419.70	23.40
2	759.90	948.70	188.80
3	1521.00	2114.15	593.15
4	1593.95	2710.10	1116.15
5	2279.96	3518.95	1238.99
6	2280.40	3011.50	731.10
7	1519.85	1745.40	225.55
8	1519.65	1667.85	148.20
9	1519.55	1628.50	108.95
10	1519.00	1606.45	87.45
11	1520.45	1597.05	76.60



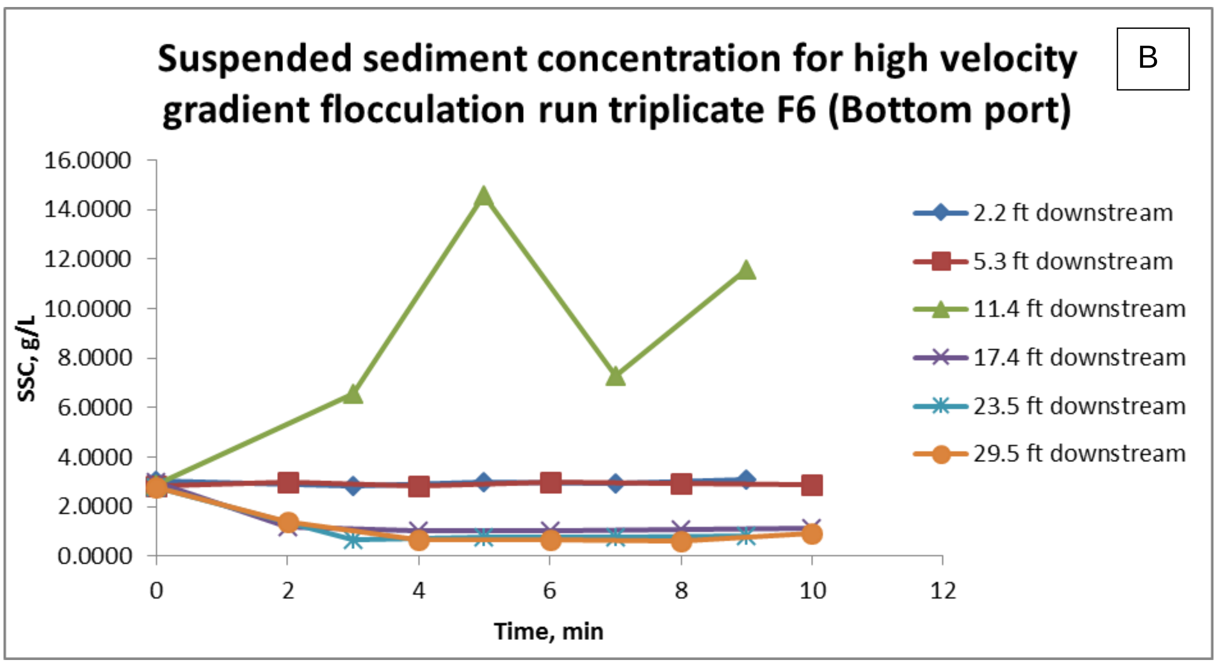


Figure 83: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

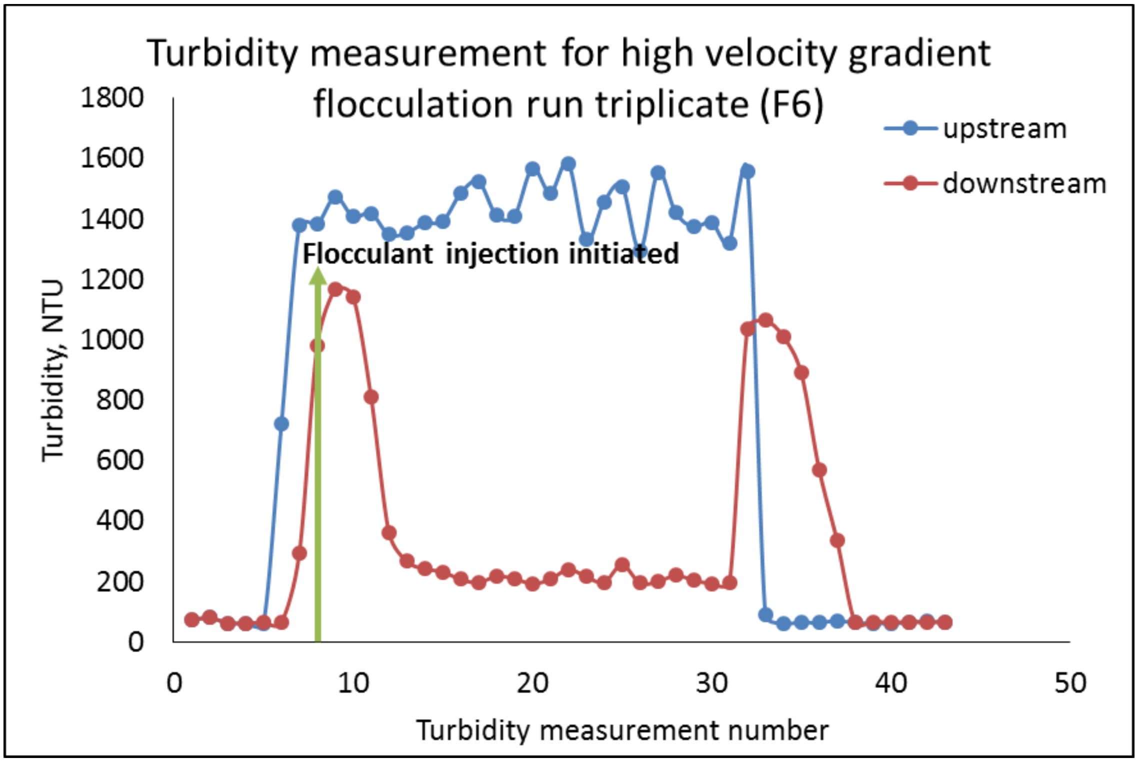


Figure 84: Graph of upstream and downstream turbidity measured for the high velocity gradient flocculation run triplicate F6.

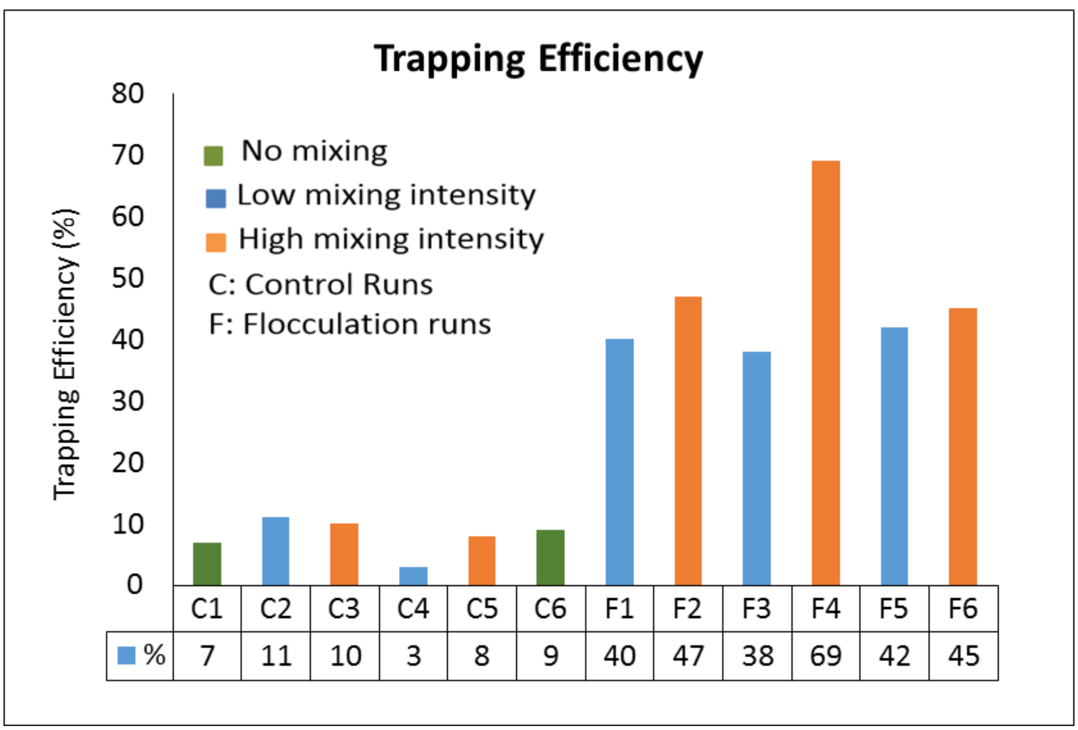


Figure 85.Trapping efficiencies for Kamie B soil.

Table 296: Values of the stickiness coefficient α for the Pacolet soil (F: Flocculation run; Number: Experiment run number)

Low Velocity Gradient Run	High Velocity Gradient Run
F1: α= 1.2	F2: α=0.89
F3 (duplicate): α= 0.89	F4 (duplicate): α= 1.5
F5 (triplicate): α=0.95	F6 (triplicate): α=0.82

Data Analysis for Norge B Soil

In the following section, data for the suspended sediment concentration and the flocculation constants for the Norge B soil are presented. The summary of all the experimental runs done on Norge B soil is presented in Table 297.

Table 297. Summary of the experimental runs done on Port B soil ('-' indicates that no data available; NA: Not Applicable).

Run No.	Description	Oscillation speed (rpm)	Velocity gradient (sec^{-1})	Sediment flow rate (l/min)	Incoming sediment concentration (g/l)	Flow rate of water (l/min)	Flocculant concentration (g/L)
C1	Control run without agitation	0	1.57	24.7	8.4	144	NA
C2	Low velocity gradient control run	99	104	20.8	18.6	170	NA
C3	High velocity gradient control run	148	134	17.2	19.4	170	NA
C4	Control run without agitation duplicate	0	1.57	17.2	19.8	171	NA
C5	Low velocity gradient control run duplicate	99	104	17.2	21.2	171	NA
C6	High velocity gradient control run duplicate	148	134	17.5	20.9	171	NA
F1	Low velocity gradient flocculation run	99	104	24.5	16.1	171	0.015
F2	High velocity gradient flocculation run	148	134	24.5	15.0	170.0	0.015
F3	Low velocity gradient flocculation run duplicate	99	104	24.5	14.22	171	0.015
F4	High velocity gradient flocculation run duplicate	148	134	24.5	15.8	171	0.015
F5	Low velocity gradient flocculation run triplicate	99	104	20	17.7	226	0.015
F6	High velocity gradient flocculation run triplicate	148	134	35.3	16.6	171	0.015

Norge B control run without agitation C1

Tables 298 to 304 shows the sediment concentration measured all the six stations and the tailgate. Table 305 shows the mass of the sediment that settled in the trays at the bottom of the flume. Figure 86 shows the concentration of the sediment measured at the top and bottom ports, and Figure 87 shows the graph of the upstream and downstream turbidity measured throughout the run.

Table 298. Suspended sediment concentration for control run without agitation C1 at Station 1 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	31.3859	26.2944	31.6700	26.9484	0.2841	0.6540	1.1364	2.6160
2	26.2965	26.3970	26.5843	26.9977	0.2878	0.6007	1.1512	2.4028
3	26.2510	26.3400	26.5538	26.8923	0.3028	0.5523	1.2112	2.2092
4	31.4707	26.2972	31.7598	26.9296	0.2891	0.6324	1.1564	2.5296
5	26.4475	26.4770	26.7520	26.9670	0.3045	0.4900	1.2180	1.9600
6	26.2808	26.2670	26.5834	26.9861	0.3026	0.7191	1.2104	2.8764

Table 299. Suspended sediment concentration for control run without agitation C1 at Station 2 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	31.4619	26.2860	31.7492	26.5772	0.2873	0.2912	1.1492	1.1648
2	31.4699	26.2035	31.7373	26.4929	0.2674	0.2894	1.0696	1.1576
3	26.4035	26.2695	26.6690	26.5518	0.2655	0.2823	1.0620	1.1292
4	26.3543	31.3500	26.6340	31.5053	0.2797	0.1553	1.1188	0.6212
5	26.2744	31.2200	26.5658	31.5141	0.2914	0.2941	1.1656	1.1764
6	31.5215	31.2624	31.8026	31.4924	0.2811	0.2300	1.1244	0.9200

Table 300. Suspended sediment concentration for control run without agitation C1 at Station 3 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	31.4136	26.2674	31.6850	26.5643	0.2714	0.2969	1.0856	1.1876
2	26.4021	31.4372	26.6752	31.7191	0.2731	0.2819	1.0924	1.1276
3	26.4654	31.3499	26.7346	31.6255	0.2692	0.2756	1.0768	1.1024
4	31.5395	31.3502	31.8170	31.6285	0.2775	0.2783	1.1100	1.1132
5	26.2559	31.3173	26.5255	31.5950	0.2696	0.2777	1.0784	1.1108
6	26.2684	31.4740	26.5460	31.7492	0.2776	0.2752	1.1104	1.1008

Table 301. Suspended sediment concentration for control run without agitation C1 at Station 4 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.2589	26.3405	26.5288	26.6169	0.2699	0.2764	1.0796	1.1056
2	26.2895	26.3741	26.5714	26.6569	0.2819	0.2828	1.1276	1.1312
3	31.3775	26.4131	31.6352	26.6978	0.2577	0.2847	1.0308	1.1388
4	31.4817	26.4019	31.7577	26.6906	0.2760	0.2887	1.1040	1.1548
5	31.2225	26.3042	31.5045	26.5950	0.2820	0.2908	1.1280	1.1632
6	31.5105	26.3324	31.7864	26.6193	0.2759	0.2869	1.1036	1.1476

Table 302. Suspended sediment concentration for control run without agitation C1 at Station 5 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.3738	31.4276	26.6511	31.6965	0.2773	0.2689	1.1092	1.0756
2	26.4148	31.1688	26.6841	31.4100	0.2693	0.2412	1.0772	0.9648
3	26.2928	26.4941	26.5659	26.7825	0.2731	0.2884	1.0924	1.1536
4	26.2988	31.4523	26.5616	31.7260	0.2628	0.2737	1.0512	1.0948
5	26.2607	26.2358	26.5346	26.5204	0.2739	0.2846	1.0956	1.1384
6	26.4773	26.2512	26.7516	26.5353	0.2743	0.2841	1.0972	1.1364

Table 303. Suspended sediment concentration for control run without agitation C1 at Station 6 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.3095	31.3570	26.5681	31.6055	0.2586	0.2485	1.0344	0.9940
2	31.2051	31.3700	31.4778	31.6504	0.2727	0.2804	1.0908	1.1216
3	26.4424	26.3150	26.7158	26.6028	0.2734	0.2878	1.0936	1.1512
4	26.3156	26.3253	26.5960	26.6074	0.2804	0.2821	1.1216	1.1284
5	26.3010	26.2530	26.5185	26.5431	0.2175	0.2901	0.8700	1.1604
6	31.4039	26.4990	31.6784	26.7876	0.2745	0.2886	1.0980	1.1544

Table 304. Suspended sediment concentration for control run without agitation C1 at tailgate ('-' indicates No data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3533	26.5159	0.1626	0.6504
2	26.2315	26.4973	0.2658	1.0632
3	31.4184	31.6555	0.2371	0.9484
4	31.4528	31.7096	0.2568	1.0272
5	31.2487	31.5200	0.2713	1.0852
6	26.3712	26.6464	0.2752	1.1008

Table 305: Mass of the sediment settled on the trays for the control run without agitation C1.

Tray Number	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	395.75	399.75	4.00
2	826.55	837.25	10.70
3	788.20	799.85	11.65
4	786.10	796.95	10.85
5	828.45	840.30	11.85
6	828.25	839.00	10.75
7	395.70	409.65	13.95
8	830.35	842.15	11.80
9	868.75	879.95	11.20
10	827.85	840.80	12.95
11	789.70	798.90	9.20

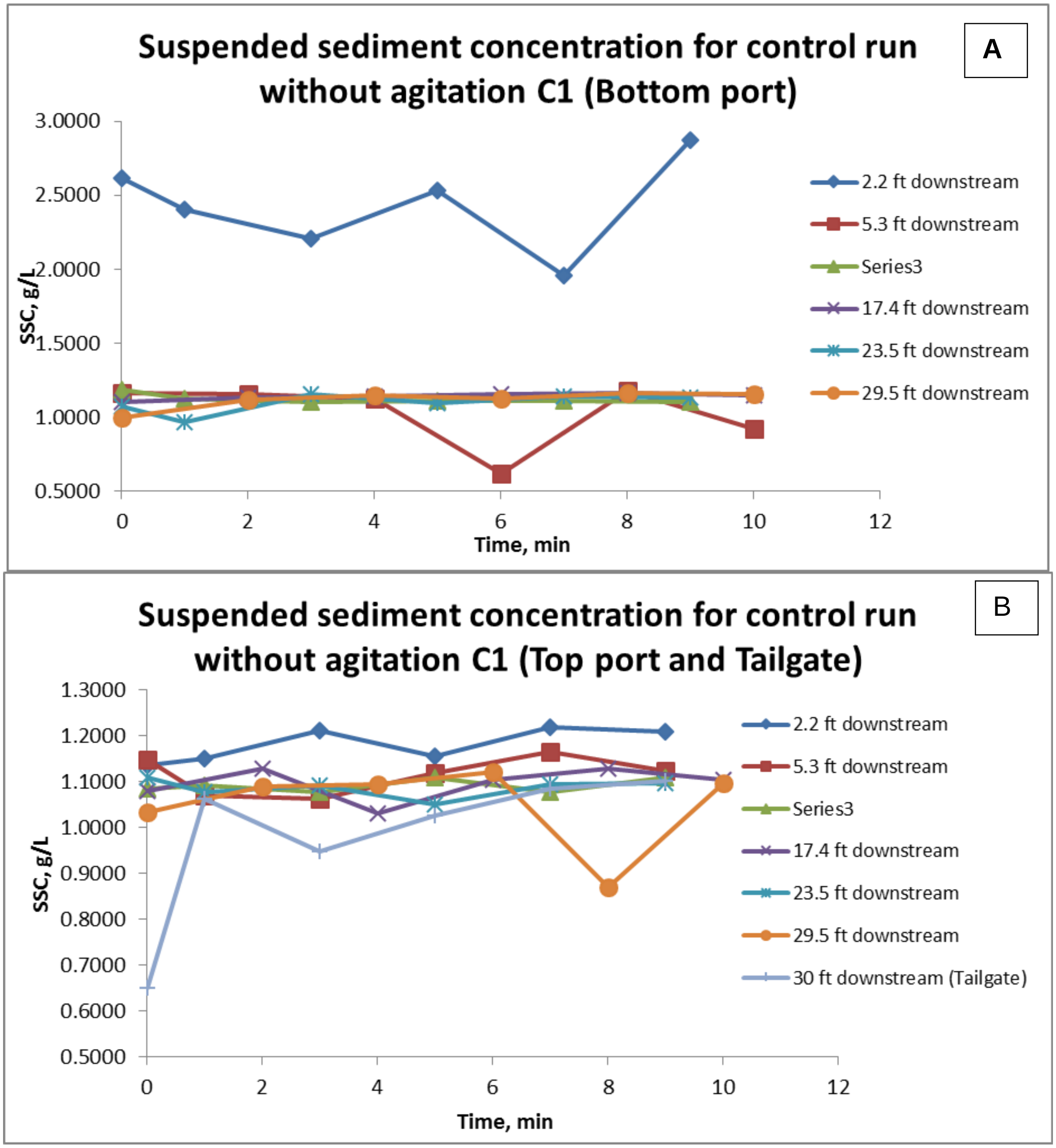


Figure 86. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

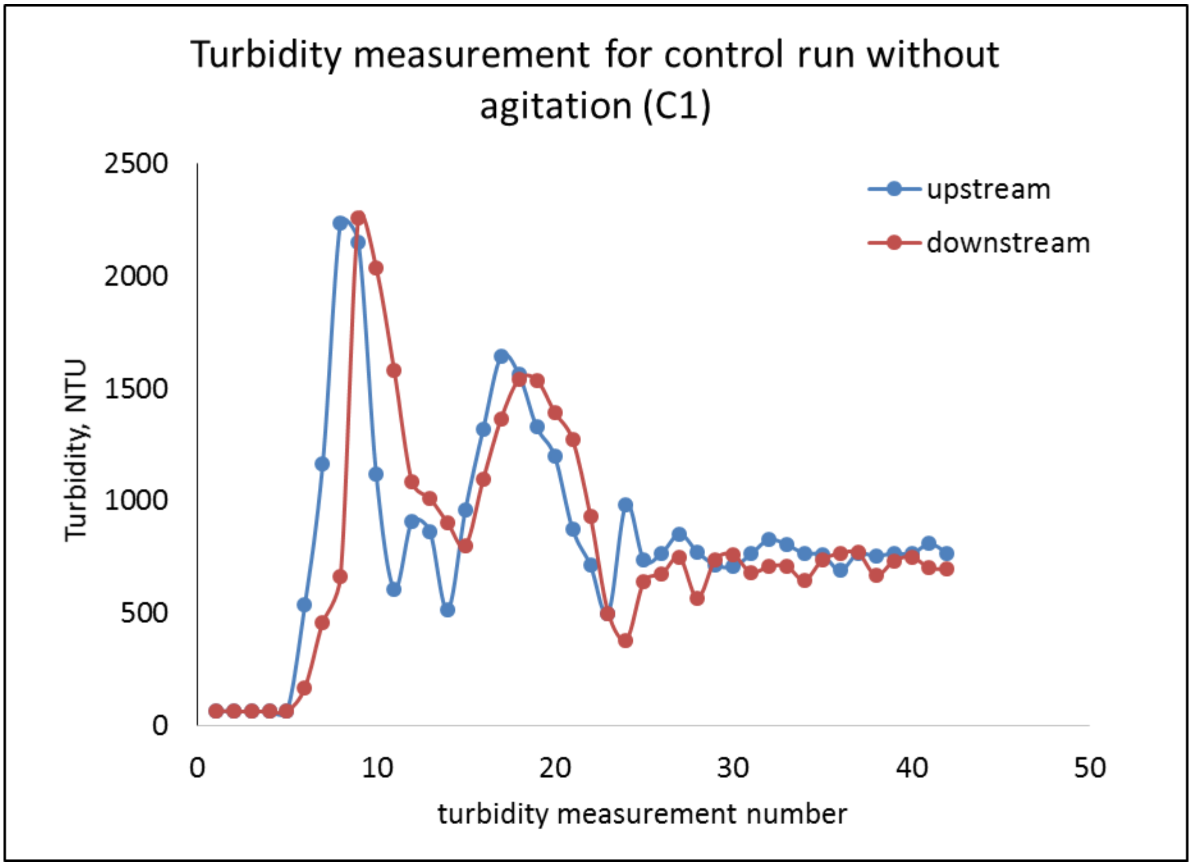


Figure 87. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument

Norge B Low Velocity Gradient Control Run (C2)

Since the nature of the control run with agitation was the same for both soils, the speed of the oscillating grids for this run was set at 99 rpm. Tables 306 to 313 show the data related to the sediment concentration measured at the sampling ports, and mass of the flocculated matter that settled in the trays respectively.

Table 306. Suspended sediment concentration for low velocity gradient control run (C2).at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3081	26.4161	26.7868	26.9111	0.4787	0.4950	1.9148	1.9800
2	31.3193	26.3856	31.7953	26.8869	0.4760	0.5013	1.9040	2.0052
3	26.4616	26.3961	26.9705	26.9131	0.5089	0.5170	2.0356	2.0680
4	26.2956	26.3373	26.7927	26.8564	0.4971	0.5191	1.9884	2.0764
5	31.4607	26.4067	31.9515	26.9240	0.4908	0.5173	1.9632	2.0692
6	26.2788	26.4476	26.7793	26.9622	0.5005	0.5146	2.0020	2.0584

Table 307. Suspended sediment concentration for low velocity gradient control run (C2).at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2748	26.3894	26.7709	26.9085	0.4961	0.5191	1.9844	2.0764
2	31.4726	26.3806	31.9475	26.8886	0.4749	0.5080	1.8996	2.0320
3	26.2431	26.1982	26.7418	26.7204	0.4987	0.5222	1.9948	2.0888
4	26.3064	26.4743	26.8148	26.9897	0.5084	0.5154	2.0336	2.0616
5	26.3039	26.2873	26.8107	26.8034	0.5068	0.5161	2.0272	2.0644
6	26.2988	26.3931	26.8105	26.9025	0.5117	0.5094	2.0468	2.0376

Table 308. Suspended sediment concentration for low velocity gradient control run (C2).at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.2850	26.4975	26.7906	27.0278	0.5056	0.5303	2.0224	2.1212
2	26.4452	31.2492	26.9600	31.7468	0.5148	0.4976	2.0592	1.9904
3	26.3143	26.2481	26.8221	26.8764	0.5078	0.6283	2.0312	2.5132
4	26.2221	26.4321	26.7228	26.9538	0.5007	0.5217	2.0028	2.0868
5	26.2426	31.3817	26.7552	31.9110	0.5126	0.5293	2.0504	2.1172
6	26.3993	26.2521	26.8861	26.7722	0.4868	0.5201	1.9472	2.0804

Table 309. Suspended sediment concentration for low velocity gradient control run (C2).at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.4186	26.3697	26.9355	26.8872	0.5169	0.5175	2.0676	2.0700
2	26.2850	26.2777	26.7940	26.8097	0.5090	0.5320	2.0360	2.1280
3	26.2319	26.4201	26.7433	26.9711	0.5114	0.5510	2.0456	2.2040
4	26.3986	26.3349	26.8533	26.8651	0.4547	0.5302	1.8188	2.1208
5	26.2498	26.4322	26.7390	26.9596	0.4892	0.5274	1.9568	2.1096
6	26.2804	26.3841	26.7673	26.9158	0.4869	0.5317	1.9476	2.1268

Table 310. Suspended sediment concentration for low velocity gradient control run (C2).at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3539	26.4017	26.8258	26.9114	0.4719	0.5097	1.8876	2.0388
2	26.2853	26.2469	26.7675	26.7562	0.4822	0.5093	1.9288	2.0372
3	26.4427	26.2690	26.9269	26.7714	0.4842	0.5024	1.9368	2.0096
4	26.3766	26.3881	26.8531	26.9030	0.4765	0.5149	1.9060	2.0596
5	26.3781	26.2520	26.8500	26.7525	0.4719	0.5005	1.8876	2.0020
6	26.2601	26.2435	26.7293	26.7412	0.4692	0.4977	1.8768	1.9908

Table 311. Suspended sediment concentration for low velocity gradient control run (C2).at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3862	31.3793	26.8745	31.8953	0.4883	0.5160	1.9532	2.0640
2	26.2495	26.4961	26.7445	27.0203	0.4950	0.5242	1.9800	2.0968
3	31.4633	26.3120	31.8716	26.8201	0.4083	0.5081	1.6332	2.0324
4	31.1129	26.4431	31.9115	26.9298	0.7986	0.4867	3.1944	1.9468
5	26.2479	26.5006	26.7114	26.9972	0.4635	0.4966	1.8540	1.9864
6	26.3126	26.4164	26.7438	26.9276	0.4312	0.5112	1.7248	2.0448

Table 312. Suspended sediment concentration for low velocity gradient control run (C2).at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	31.4339	31.8964	0.4625	1.8500
2	26.4696	26.9788	0.5092	2.0368
3	26.2922	26.8042	0.5120	2.0480
4	26.3479	26.8714	0.5235	2.0940
5	26.2542	26.7601	0.5059	2.0236
6	26.4783	26.9121	0.4338	1.7352

Table 313. Mass of the sediment settled in the trays for low velocity gradient control run (C2).

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.35	442.5	9.15
2	826.8	852.55	25.75
3	434.8	458.3	23.50
4	827.65	854.25	26.60
5	786.15	813.8	27.65
6	871.8	900.35	28.55
7	396.3	421.95	25.65
8	789.15	815.9	26.75
9	827.5	859	31.50
10	786.15	805.15	19.00
11	785.9	808.55	22.65

Figure 88 below shows the graph of the sediment concentration for this run, and Figure 89 shows the graph of the upstream and downstream turbidity.

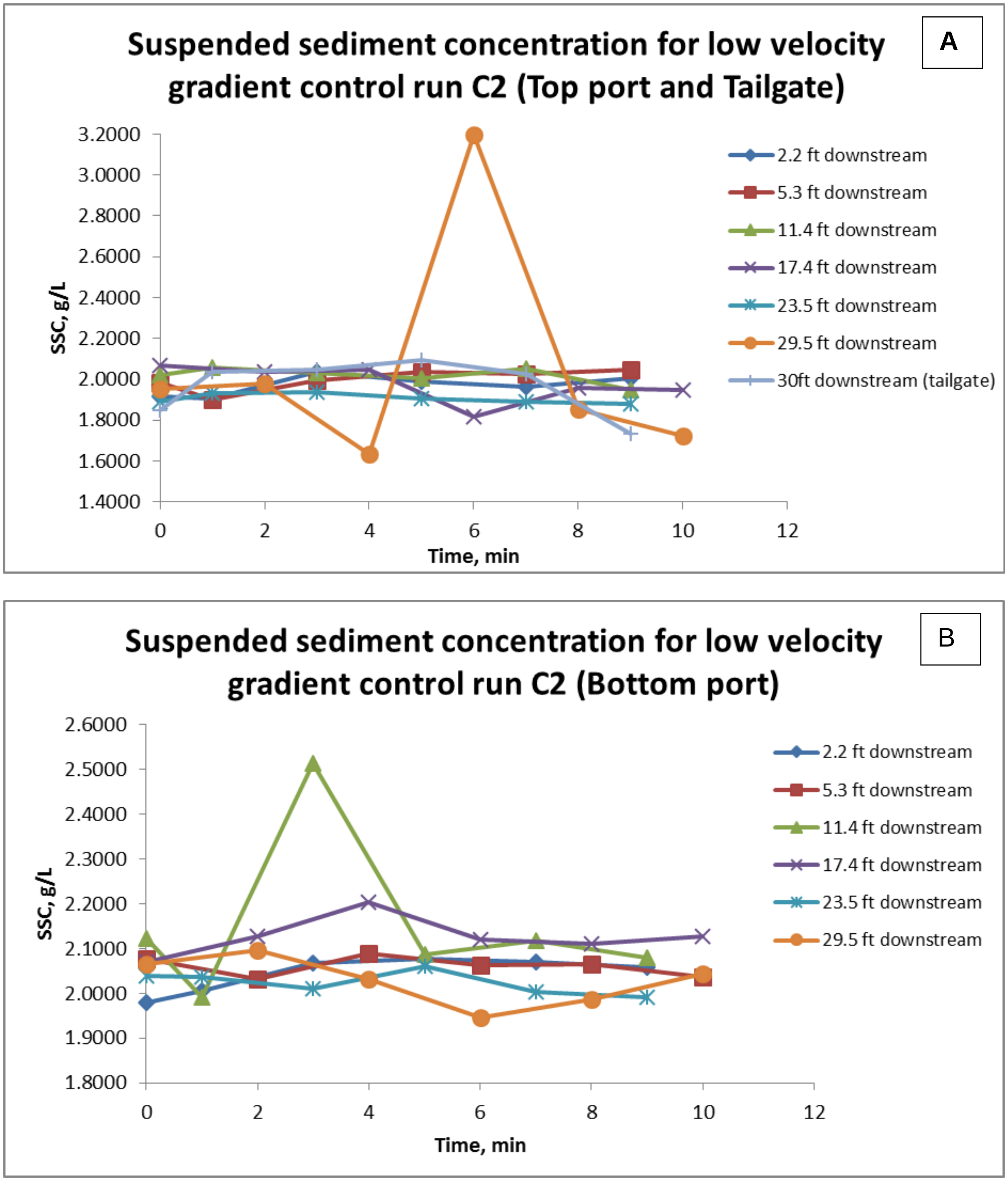


Figure 88. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1-minute interval from odd numbered and even numbered stations alternately

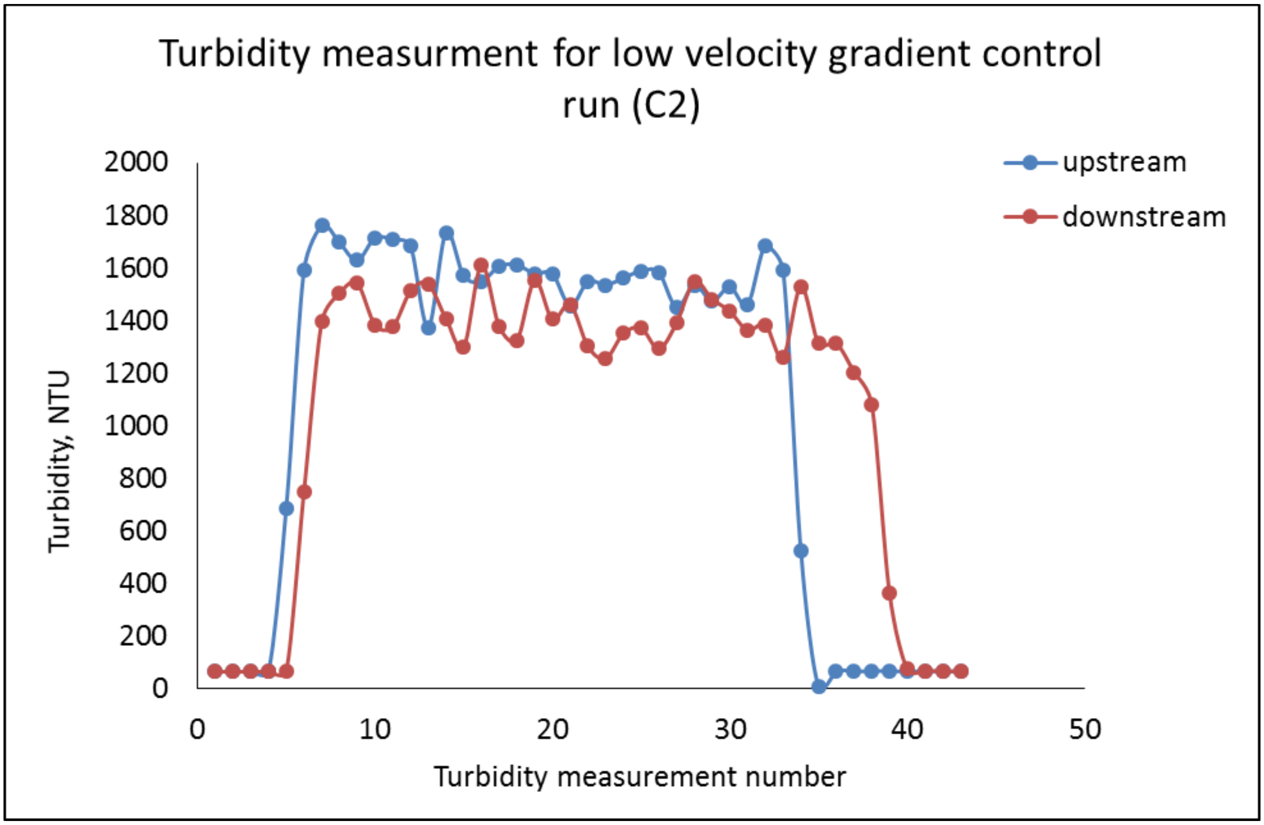


Figure 89. Upstream and downstream turbidity for low velocity gradient control run C2. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument

<u>Norge B high velocity gradient control run (C3)</u>

Tables 314 to 320 shows the data for the concentration of the suspended sediments, and Table 321 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 90 and 91 shows the graph of the suspended sediment concentration and the measured upstream and downstream turbidity

Table 314. Suspended sediment concentration for high velocity gradient control run C3 at Station 1('-'indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3647	31.3905	31.8458	31.8457	0.4811	0.4552	1.9244	1.8208
2	26.3045	31.3866	26.7821	31.8661	0.4776	0.4795	1.9104	1.9180
3	26.3936	26.4080	26.8810	26.8867	0.4874	0.4787	1.9496	1.9148
4	26.4909	26.6886	26.9723	26.9461	0.4814	0.2575	1.9256	1.0300
5	26.2904	26.2392	26.7982	26.6509	0.5078	0.4117	2.0312	1.6468
6	31.1574	26.2709	31.6442	26.7608	0.4868	0.4899	1.9472	1.9596

Table 315. Suspended sediment concentration for high velocity gradient control run C3 at Station 2('-'indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.6246	26.2683	31.9271	26.7688	0.3025	0.5005	1.2100	2.0020
2	26.5618	26.7578	26.8478	26.8806	0.2860	0.1228	1.1440	0.4912
3	26.4176	31.4837	26.7908	31.9424	0.3732	0.4587	1.4928	1.8348
4	31.1603	26.5468	31.6554	26.9867	0.4951	0.4399	1.9804	1.7596
5	26.7117	26.5709	26.9244	26.8868	0.2127	0.3159	0.8508	1.2636
6	26.7453	31.3536	26.9671	31.8510	0.2218	0.4974	0.8872	1.9896

Table 316. Suspended sediment concentration for high velocity gradient control run C3 at Station 3('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3447	26.2714	26.8537	27.5645	0.5090	1.2931	2.0360	5.1724
2	31.5314	26.2592	31.9350	26.7820	0.4036	0.5228	1.6144	2.0912
3	26.3701	31.4273	26.8225	31.9184	0.4524	0.4911	1.8096	1.9644
4	26.3490	31.0168	26.8662	31.8437	0.5172	0.8269	2.0688	3.3076
5	26.4134	26.5001	26.9065	27.0188	0.4931	0.5187	1.9724	2.0748
6	26.2750	26.4048	26.7662	26.9187	0.4912	0.5139	1.9648	2.0556

Table 317. Suspended sediment concentration for high velocity gradient control run C3 at Station 4('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2691	31.4651	26.7933	31.9734	0.5242	0.5083	2.0968	2.0332
2	26.2521	31.3486	26.7331	31.8480	0.4810	0.4994	1.9240	1.9976
3	26.3510	26.3896	26.8445	26.8977	0.4935	0.5081	1.9740	2.0324
4	31.3842	31.4722	31.8346	31.6380	0.4504	0.1658	1.8016	0.6632
5	26.3086	26.2280	26.7922	26.7326	0.4836	0.5046	1.9344	2.0184
6	26.2307	31.4947	26.7039	32.0070	0.4732	0.5123	1.8928	2.0492

Table 318. Suspended sediment concentration for high velocity gradient control run C3 at Station 5('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2968	26.2987	26.7785	26.8152	0.4817	0.5165	1.9268	2.0660
2	31.3830	26.3768	31.8561	26.8523	0.4731	0.4755	1.8924	1.9020
3	31.4976	31.3444	31.9452	31.8683	0.4476	0.5239	1.7904	2.0956
4	26.2619	31.4172	26.7363	31.8878	0.4744	0.4706	1.8976	1.8824
5	31.3643	26.3053	31.8224	26.7895	0.4581	0.4842	1.8324	1.9368
6	26.2500	26.3208	26.7190	26.8056	0.4690	0.4848	1.8760	1.9392

Table 319. Suspended sediment concentration for high velocity gradient control run C3 at Station 6('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4273	26.2569	31.9218	26.7922	0.4945	0.5353	1.9780	2.1412
2	26.2572	31.3434	26.7363	31.8344	0.4791	0.4910	1.9164	1.9640
3	26.2623	26.3028	26.7464	26.7982	0.4841	0.4954	1.9364	1.9816
4	26.3886	26.4024	26.8637	26.8949	0.4751	0.4925	1.9004	1.9700
5	26.2888	31.6686	26.7703	31.8874	0.4815	0.2188	1.9260	0.8752
6	26.3389	31.7895	26.8150	31.9112	0.4761	0.1217	1.9044	0.4868

Table 320. Suspended sediment concentration for high velocity gradient control run C3 at tailgate ('-' indicates no data).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.4848	26.9152	0.4304	1.7216
2	26.3087	26.7908	0.4821	1.9284
3	31.3654	31.8196	0.4542	1.8168
4	31.3770	31.8420	0.4650	1.8600
5	26.4469	26.8956	0.4487	1.7948
6	31.4452	31.9112	0.4660	1.8640

Table 321. Mass of settled sediments in the trays for high velocity gradient control run C3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.20	397.30	4.10
2	789.75	807.20	17.45
3	392.80	408.00	15.20
4	785.35	804.40	19.05
5	830.60	848.85	18.25
6	789.25	807.85	18.60
7	433.90	451.65	17.75
8	827.45	844.75	17.30
9	830.50	853.30	22.80
10	826.65	841.85	15.20
11	867.95	885.90	17.95

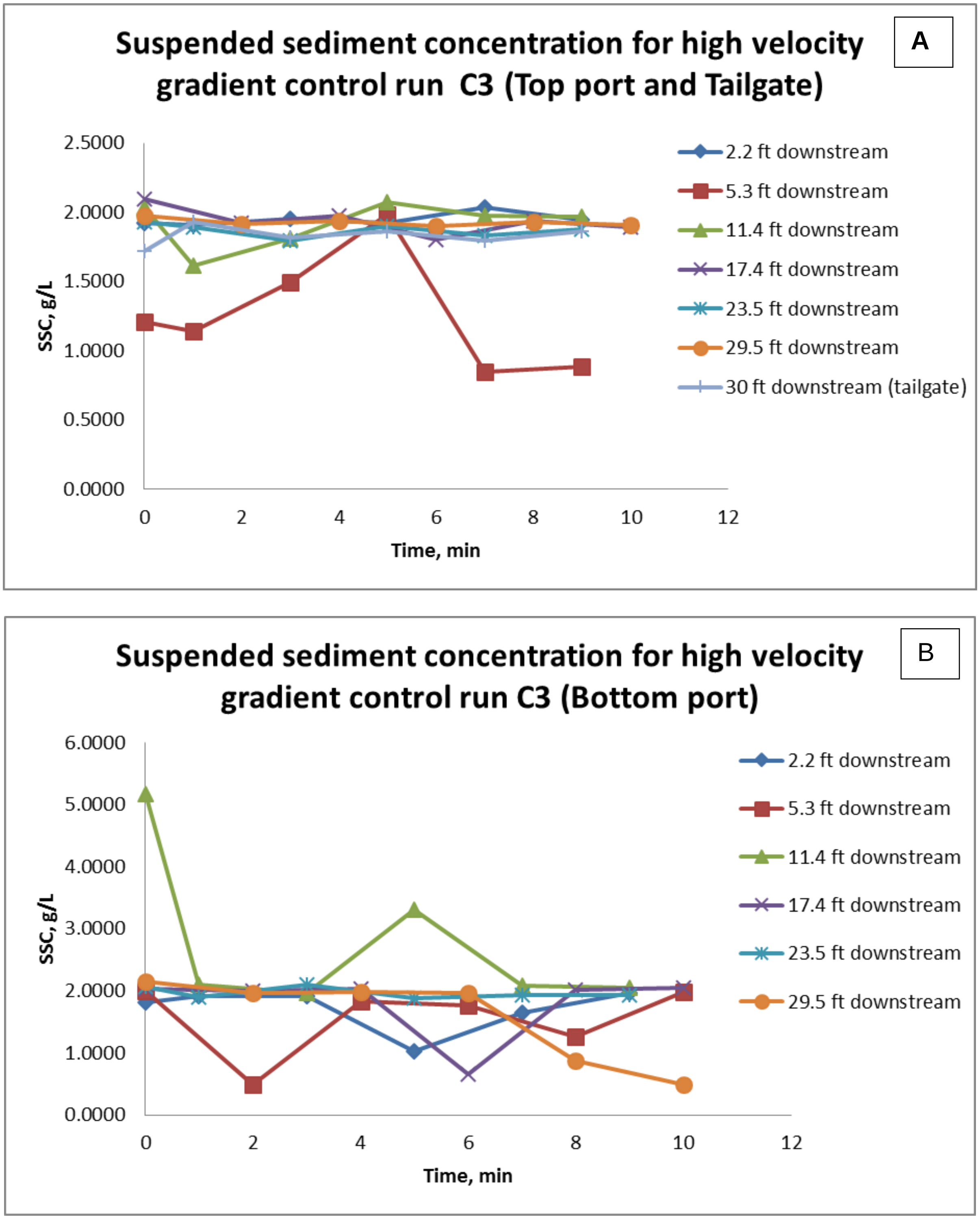


Figure 90. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

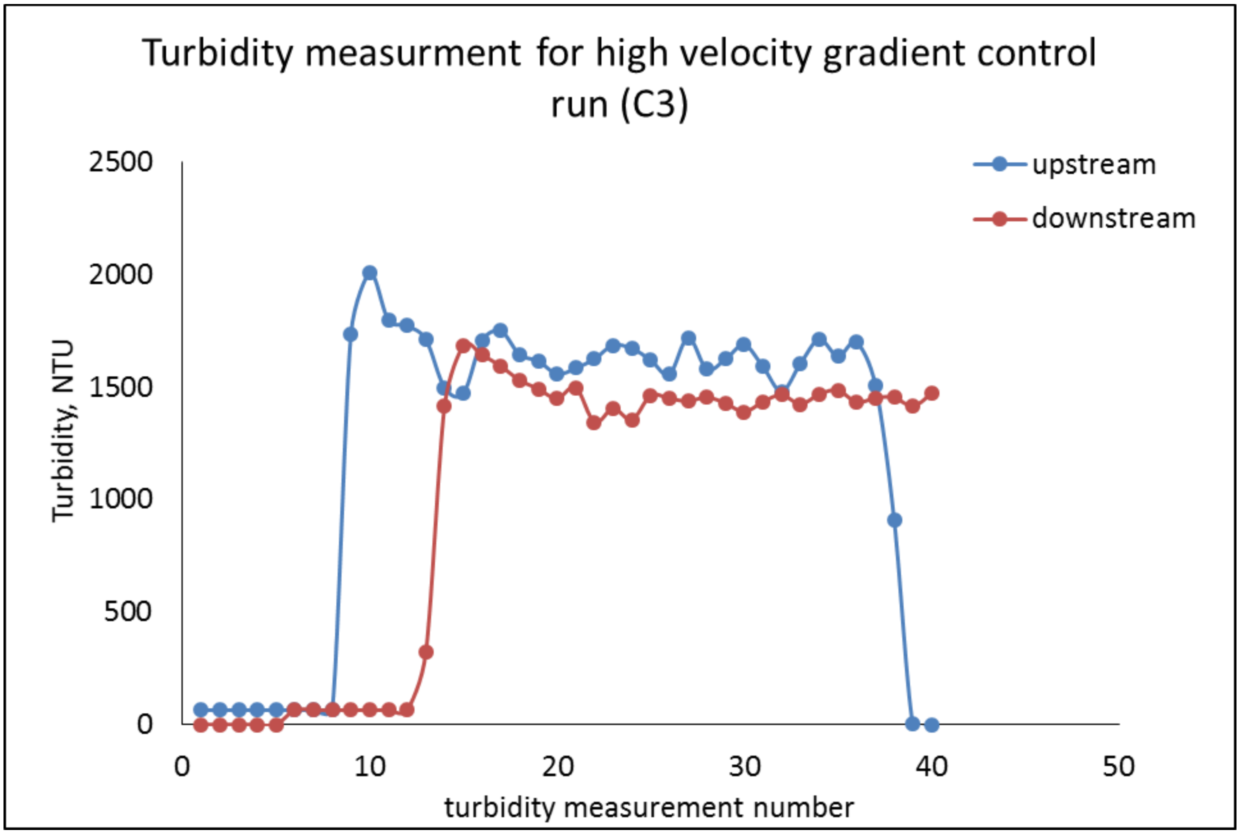


Figure 91. Upstream and downstream turbidity for high velocity gradient control run C3. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument

<u>Norge B Control Run without agitation (C4)</u>

Tables 322 to 329 show the data related to the control run C4, and Figure 96 shows the graph of the suspended sediment concentration. Figure 92 shows the graph of the upstream and downstream turbidity measured for this run.

Table 322. Suspended sediment concentration for control run without agitation duplicate C4.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2818	26.5149	26.7733	27.0164	0.4915	0.5015	1.9660	2.0060
2	31.4480	26.3996	31.9289	26.9141	0.4809	0.5145	1.9236	2.0580
3	26.2753	26.3761	26.7551	26.8476	0.4798	0.4715	1.9192	1.8860
4	31.2783	26.3026	31.7545	26.8173	0.4762	0.5147	1.9048	2.0588
5	26.4121	31.4519	26.8907	31.9377	0.4786	0.4858	1.9144	1.9432
6	26.2829	31.4781	26.7651	31.9571	0.4822	0.4790	1.9288	1.9160

Table 323. Suspended sediment concentration for control run without agitation duplicate C4.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4730	26.3280	26.9268	26.8171	0.4538	0.4891	1.8152	1.9564
2	26.2712	31.5179	26.7602	31.9558	0.4890	0.4379	1.9560	1.7516
3	31.5288	26.2931	32.0001	26.7844	0.4713	0.4913	1.8852	1.9652
4	31.5238	26.4956	32.0038	26.9880	0.4800	0.4924	1.9200	1.9696
5	26.3887	26.3370	26.8748	26.8237	0.4861	0.4867	1.9444	1.9468
6	26.2738	31.4064	26.7574	31.8899	0.4836	0.4835	1.9344	1.9340

Table 324. Suspended sediment concentration for control run without agitation duplicate C4.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2800	31.4603	26.6385	31.9207	0.3585	0.4604	1.4340	1.8416
2	31.3306	26.3175	31.7805	26.7951	0.4499	0.4776	1.7996	1.9104
3	31.4430	31.4177	31.8882	31.8827	0.4452	0.4650	1.7808	1.8600
4	26.3724	31.3630	26.8367	31.8284	0.4643	0.4654	1.8572	1.8616
5	26.4318	31.4133	26.8846	31.8635	0.4528	0.4502	1.8112	1.8008
6	31.3746	26.3964	31.8030	26.8686	0.4284	0.4722	1.7136	1.8888

Table 325. Suspended sediment concentration for control run without agitation duplicate C4.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3177	26.3884	26.7806	26.9043	0.4629	0.5159	1.8516	2.0636
2	26.2663	31.4180	26.7387	31.8968	0.4724	0.4788	1.8896	1.9152
3	31.5021	26.3940	31.9356	26.8802	0.4335	0.4862	1.7340	1.9448
4	31.4395	31.5597	31.9012	32.0479	0.4617	0.4882	1.8468	1.9528
5	26.3048	26.2704	26.7766	26.7689	0.4718	0.4985	1.8872	1.9940
6	26.3847	31.3849	26.8681	31.8833	0.4834	0.4984	1.9336	1.9936

Table 326. Suspended sediment concentration for control run without agitation duplicate C4.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	31.4705	26.3142	31.9464	26.7871	0.4759	0.4729	1.9036	1.8916
2	26.4298	26.4947	26.9008	26.9687	0.4710	0.4740	1.8840	1.8960
3	26.2726	26.4757	26.7375	26.9734	0.4649	0.4977	1.8596	1.9908
4	26.4143	26.4107	26.8708	26.8832	0.4565	0.4725	1.8260	1.8900
5	26.2198	26.3408	26.7836	26.8473	0.5638	0.5065	2.2552	2.0260
6	26.4539	26.4335	26.9375	26.9082	0.4836	0.4747	1.9344	1.8988

Table 327. Suspended sediment concentration for control run without agitation duplicate C4.at Station 6

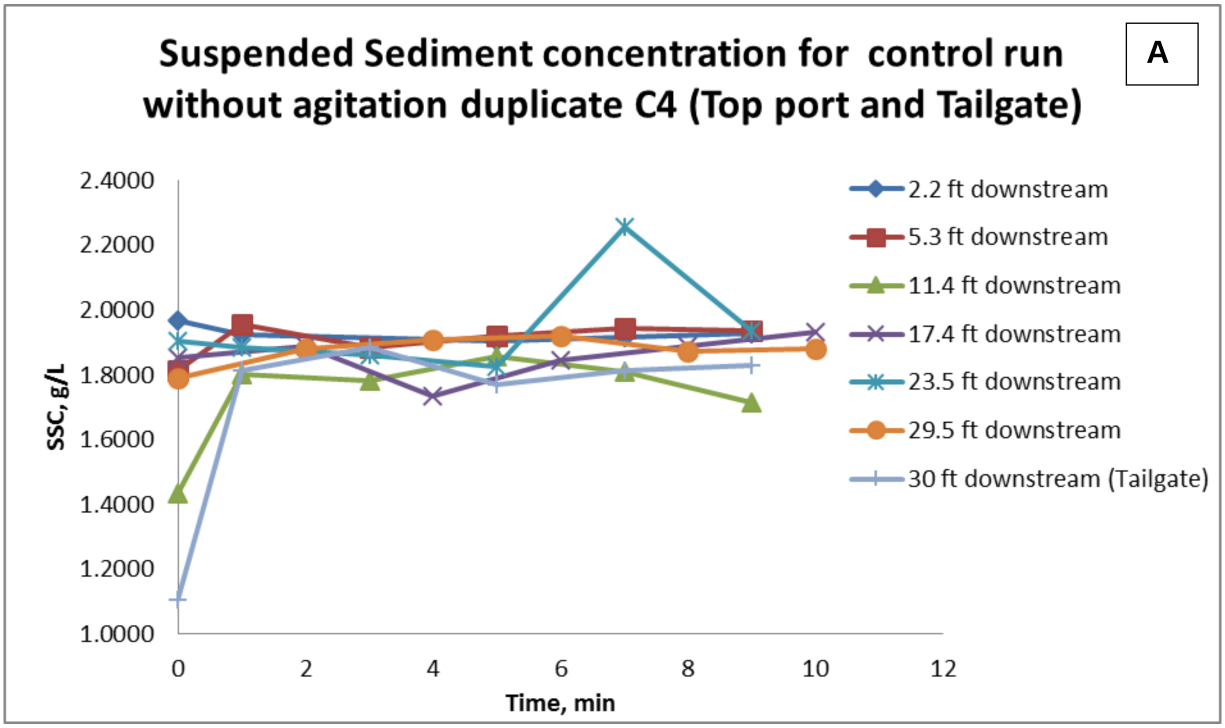
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.3124	31.3322	26.7594	31.7987	0.4470	0.4665	1.7880	1.8658
2	26.2661	26.3915	26.7362	26.8838	0.4701	0.4923	1.8804	1.9692
3	31.4140	26.3595	31.8913	26.8618	0.4773	0.5023	1.9092	2.0092
4	26.3024	26.4891	26.7828	26.9891	0.4804	0.5000	1.9216	2.0000
5	26.4230	26.2549	26.8912	26.7386	0.4682	0.4837	1.8728	1.9348
6	26.3034	26.2565	26.7735	26.7354	0.4701	0.4789	1.8804	1.9156

Table 328. Suspended sediment concentration for control run without agitation duplicate C4.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.2523	26.5290	0.2767	1.1068
2	31.4742	31.9277	0.4535	1.8140
3	26.3440	26.8149	0.4709	1.8836
4	31.3858	31.8281	0.4423	1.7692
5	26.3286	26.7824	0.4538	1.8152
6	26.4747	26.9324	0.4577	1.8308

Table 329. Mass of settled sediments in the trays for control run without agitation C4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.30	439.70	6.40
2	826.05	841.75	15.70
3	434.60	449.95	15.35
4	393.65	408.35	14.70
5	785.50	802.45	16.95
6	871.05	886.85	15.80
7	396.00	411.05	15.05
8	788.10	803.55	15.45
9	826.90	844.85	17.95
10	785.15	798.90	13.75
11	785.35	799.95	14.60



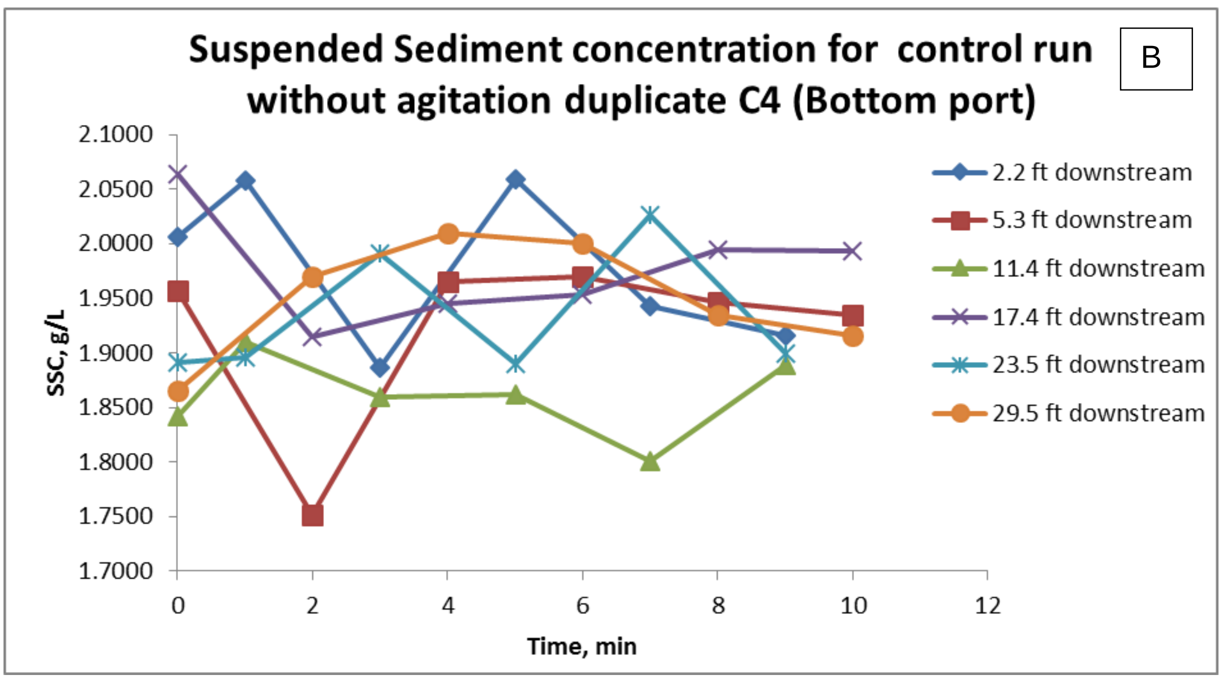


Figure 92. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

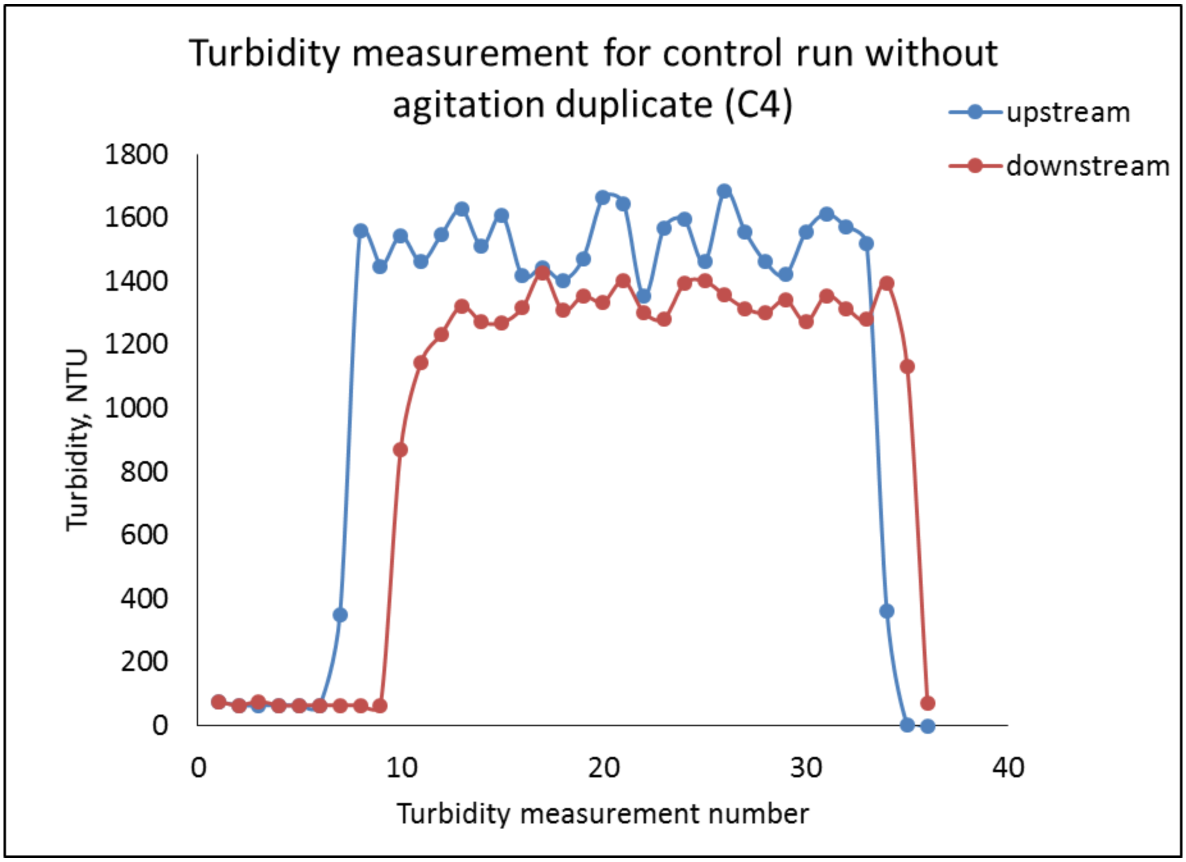


Figure 93. Upstream and downstream turbidity for control run without agitation duplicate C4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Norge B Low velocity gradient control run duplicate C5</u>

Tables 330 to 337 show the measured data for this run, and Figure 94 shows the graph of the sediment concentration and Figure 95 shows the graph of the upstream and the downstream turbidity

Table 330. Suspended sediment concentration for low velocity gradient control run duplicate C5 at Station 1('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3007	26.4057	26.7754	26.9200	0.4747	0.5143	1.8988	2.0572
2	31.3889	26.3915	31.7874	26.8941	0.3985	0.5026	1.5940	2.0104
3	26.4877	26.4194	26.9653	26.8992	0.4776	0.4798	1.9104	1.9192
4	26.3525	26.3678	26.7692	26.8285	0.4167	0.4607	1.6668	1.8428
5	31.4925	26.4524	31.9483	26.9143	0.4558	0.4619	1.8232	1.8476
6	26.3033	26.4572	26.7915	26.6472	0.4882	0.1900	1.9528	0.7600

Table 331. Suspended sediment concentration for low velocity gradient control run duplicate C5 at Station 2('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3088	26.4290	26.7706	26.8891	0.4618	0.4601	1.8472	1.8404
2	31.4937	26.4137	31.9463	26.8725	0.4526	0.4588	1.8104	1.8352
3	26.2777	26.2035	26.7149	26.6859	0.4372	0.4824	1.7488	1.9296
4	26.3130	26.4818	26.7966	26.9903	0.4836	0.5085	1.9344	2.0340
5	26.3224	26.3185	26.8183	26.7829	0.4959	0.4644	1.9836	1.8576
6	26.3238	26.4012	26.7824	26.8564	0.4586	0.4552	1.8344	1.8208

Table 332. Suspended sediment concentration for low velocity gradient control run duplicate C5 at Station 3('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3110	26.5214	26.7885	27.0376	0.4775	0.5162	1.9100	2.0648
2	26.4666	31.2713	26.9534	31.7442	0.4868	0.4729	1.9472	1.8916
3	26.3652	26.3557	26.8318	26.8592	0.4666	0.5035	1.8664	2.0140
4	26.2421	26.4750	26.7259	26.9737	0.4838	0.4987	1.9352	1.9948
5	26.2489	31.4203	26.7780	31.9025	0.5291	0.4822	2.1164	1.9288
6	26.4276	26.2520	26.8750	26.9581	0.4474	0.7061	1.7896	2.8244

Table 333. Suspended sediment concentration for low velocity gradient control run duplicate C5 at Station 4('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4157	26.3569	26.9268	26.8812	0.5111	0.5243	2.0444	2.0972
2	26.2956	26.2869	26.7959	26.8099	0.5003	0.5230	2.0012	2.0920
3	26.2356	26.4195	26.7446	26.9404	0.5090	0.5209	2.0360	2.0836
4	26.3936	26.3369	26.8827	26.8353	0.4891	0.4984	1.9564	1.9936
5	26.2396	26.4340	26.7386	26.9693	0.4990	0.5353	1.9960	2.1412
6	26.2924	26.3909	26.8020	26.9219	0.5096	0.5310	2.0384	2.1240

Table 334. Suspended sediment concentration for low velocity gradient control run duplicate at Station 5 (‘-‘ indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3557	26.4122	26.8203	26.8932	0.4646	0.4810	1.8584	1.9240
2	26.3020	26.2698	26.7666	26.7436	0.4646	0.4738	1.8584	1.8952
3	26.4439	26.2721	26.9258	26.7722	0.4819	0.5001	1.9276	2.0004
4	26.3758	26.3871	26.8569	26.8876	0.4811	0.5005	1.9244	2.0020
5	26.3766	26.2490	26.8406	26.7426	0.4640	0.4936	1.8560	1.9744
6	26.2507	26.2403	26.7358	26.7392	0.4851	0.4989	1.9404	1.9956

Table 335. Suspended sediment concentration for low velocity gradient control run duplicate C5 at Station 6(‘-‘ indicates no data available).

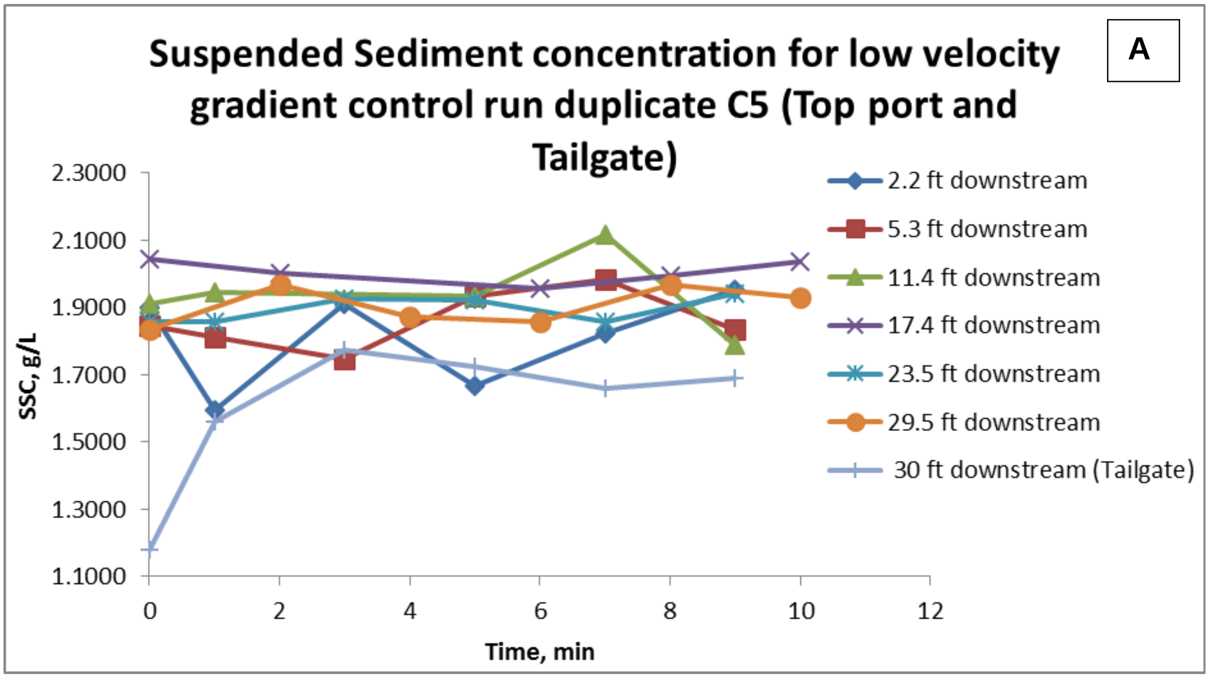
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3857	31.4088	26.8449	31.8818	0.4592	0.4730	1.8368	1.8920
2	26.2541	26.5026	26.7461	27.0046	0.4920	0.5020	1.9680	2.0080
3	31.4082	26.2989	31.8765	26.7953	0.4683	0.4964	1.8732	1.9856
4	31.4568	26.4130	31.9212	26.9224	0.4644	0.5094	1.8576	2.0376
5	26.2218	26.4751	26.7137	26.9808	0.4919	0.5057	1.9676	2.0228
6	26.2554	26.4035	26.7377	26.9199	0.4823	0.5164	1.9292	2.0656

Table 336. Suspended sediment concentration for low velocity gradient control run duplicate C5 at tailgate('-' indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment conc g/L
1	31.4304	31.7250	0.2946	1.1784
2	26.5115	26.9018	0.3903	1.5612
3	26.3215	26.7652	0.4437	1.7748
4	26.4017	26.8324	0.4307	1.7228
5	26.2918	26.7065	0.4147	1.6588
6	26.4436	26.8658	0.4222	1.6888

Table 337. Mass of settled sediments in the trays for low velocity gradient control run duplicate C5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.85	403.05	10.20
2	867.15	892.3	25.15
3	435.15	458.3	23.15
4	395.9	420.4	24.50
5	790.95	817.85	26.90
6	826.1	857.85	31.75
7	434.85	457.9	23.05
8	826.5	847.7	21.20
9	831.65	857.15	25.50
10	789.45	812.85	23.40
11	825.55	850.65	25.10



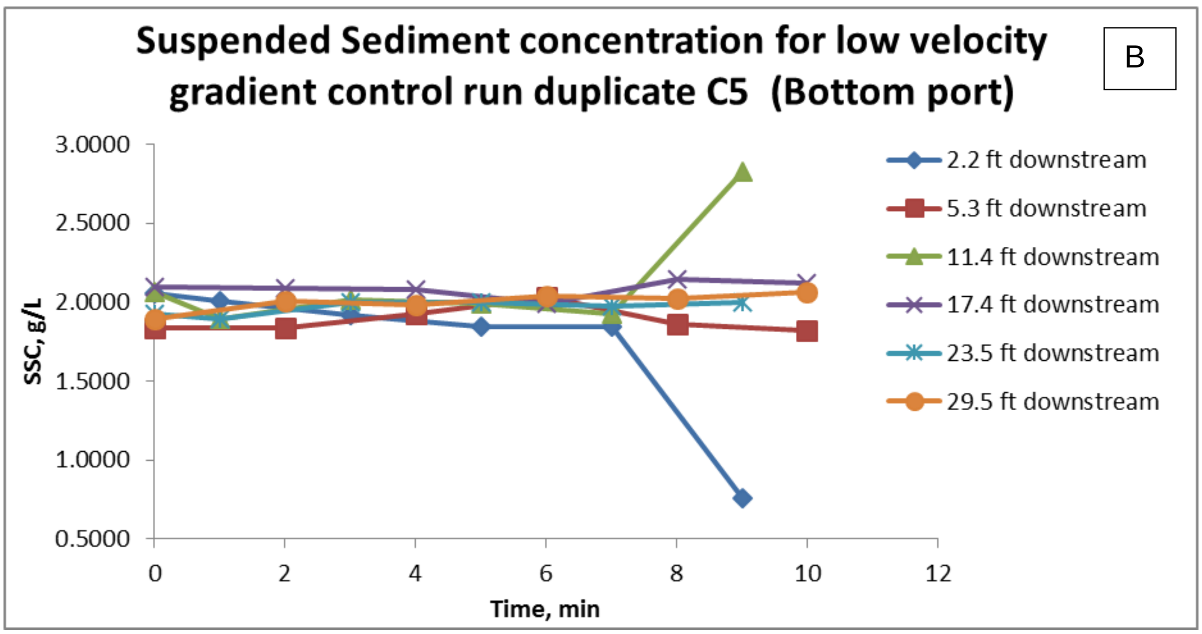


Figure 94. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

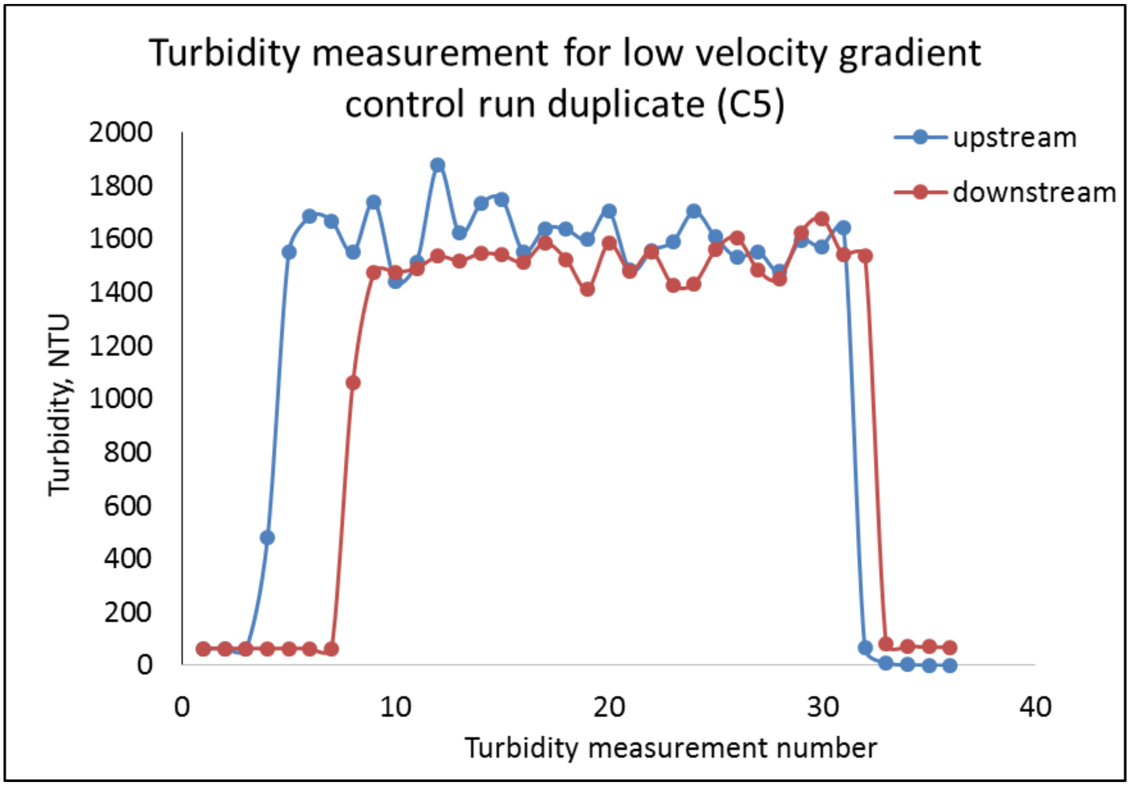


Figure 95. Upstream and downstream turbidity for low velocity gradient control run duplicate C5. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

<u>Norge B High velocity gradient control Run Duplicate (C6)</u>

The oscillating grid speed was set at 148 rpm. Tables 338 to 345 show the data related to this run, and Figure 96 shows the graph of the sediment concentration. Figure 97 shows the graph of the upstream and downstream turbidity.

Table 338. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4373	26.3520	26.9551	26.8891	0.5178	0.5371	2.0712	2.1484
2	26.2826	26.2765	26.8045	26.8169	0.5219	0.5404	2.0876	2.1616
3	26.2815	31.4642	26.7902	31.9339	0.5087	0.4697	2.0348	1.8788
4	26.3516	26.4326	26.8613	26.9372	0.5097	0.5046	2.0388	2.0184
5	26.2727	31.3899	26.7624	31.8824	0.4897	0.4925	1.9588	1.9700
6	31.4209	26.5445	31.8715	26.9083	0.4506	0.3638	1.8024	1.4552

Table 339. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	31.3976	31.3910	31.8189	31.9194	0.4213	0.5284	1.6852	2.1136
2	31.4971	31.3870	32.0689	31.8963	0.5718	0.5093	2.2872	2.0372
3	31.3802	26.4818	31.8785	26.9456	0.4983	0.4638	1.9932	1.8552
4	26.2917	26.3773	26.8650	26.9124	0.5733	0.5351	2.2932	2.1404
5	26.2753	31.4423	26.8613	32.0109	0.5860	0.5686	2.3440	2.2744
6	31.4723	26.2227	31.9801	26.8112	0.5078	0.5885	2.0312	2.3540

Table 340. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.3670	26.4298	26.9248	26.9520	0.5578	0.5222	2.2312	2.0888
2	26.4027	31.3842	26.9536	31.9275	0.5509	0.5433	2.2036	2.1732
3	31.4426	26.3870	31.9789	26.9559	0.5363	0.5689	2.1452	2.2756
4	26.2810	26.4977	26.8344	26.9924	0.5534	0.4947	2.2136	1.9788
5	26.3873	26.3002	26.9400	26.8461	0.5527	0.5459	2.2108	2.1836
6	31.3771	31.4305	31.9241	31.9148	0.5470	0.4843	2.1880	1.9372

Table 341. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 4 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3630	26.2997	26.8642	26.8872	0.5012	0.5875	2.0048	2.3500
2	26.4938	31.3998	27.0638	31.9863	0.5700	0.5865	2.2800	2.3460
3	26.3335	26.3260	26.9014	26.9150	0.5679	0.5890	2.2716	2.3560
4	26.3022	31.3552	26.8496	31.8597	0.5474	0.5045	2.1896	2.0180
5	26.4102	26.2509	26.9803	26.7859	0.5701	0.5350	2.2804	2.1400
6	26.4195	26.5224	26.9896	27.0788	0.5701	0.5564	2.2804	2.2256

Table 342. Suspended sediment concentration for high velocity gradient control run C6 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3867	26.4900	26.9102	27.0448	0.5235	0.5548	2.0940	2.2192
2	26.4210	31.3735	26.9643	31.8184	0.5433	0.4449	2.1732	1.7796
3	31.3989	26.3738	31.8949	26.9412	0.4960	0.5674	1.9840	2.2696
4	31.4027	26.4114	31.8942	26.9759	0.4915	0.5645	1.9660	2.2580
5	26.3911	26.3813	26.9335	26.9644	0.5424	0.5831	2.1696	2.3324
6	26.2418	26.2763	26.7828	26.8412	0.5410	0.5649	2.1640	2.2596

Table 343. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 6 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4540	26.3002	26.9945	26.8648	0.5405	0.5646	2.1620	2.2584
2	26.4901	26.3274	27.0316	26.9030	0.5415	0.5756	2.1660	2.3024
3	26.2624	26.5834	26.8103	27.1233	0.5479	0.5399	2.1916	2.1596
4	26.2639	31.4496	26.7922	31.9557	0.5283	0.5061	2.1132	2.0244
5	26.3885	26.2926	26.9253	26.8650	0.5368	0.5724	2.1472	2.2896
6	26.3960	31.3390	26.9285	31.8832	0.5325	0.5442	2.1300	2.1768

Table 344. Suspended sediment concentration for high velocity gradient control run duplicate C6 at tailgate (‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.4757	27.0364	0.5607	2.2428
2	26.4484	27.0023	0.5539	2.2156
3	26.3997	26.9368	0.5371	2.1484
4	26.4346	27.0023	0.5677	2.2708
5	26.2568	26.8024	0.5456	2.1824
6	26.3725	26.9764	1.6039	2.4156

Table 345. Mass of the sediment settled in the trays for high velocity gradient control run duplicate C6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.45	440.20	6.75
2	826.45	843.80	17.35
3	871.20	894.10	22.90
4	786.95	810.95	24.00
5	786.05	806.70	20.65
6	871.20	895.95	24.75
7	395.00	420.40	25.40
8	829.00	848.65	19.65
9	826.85	851.05	24.20
10	788.25	797.55	9.30
11	785.60	801.50	15.90

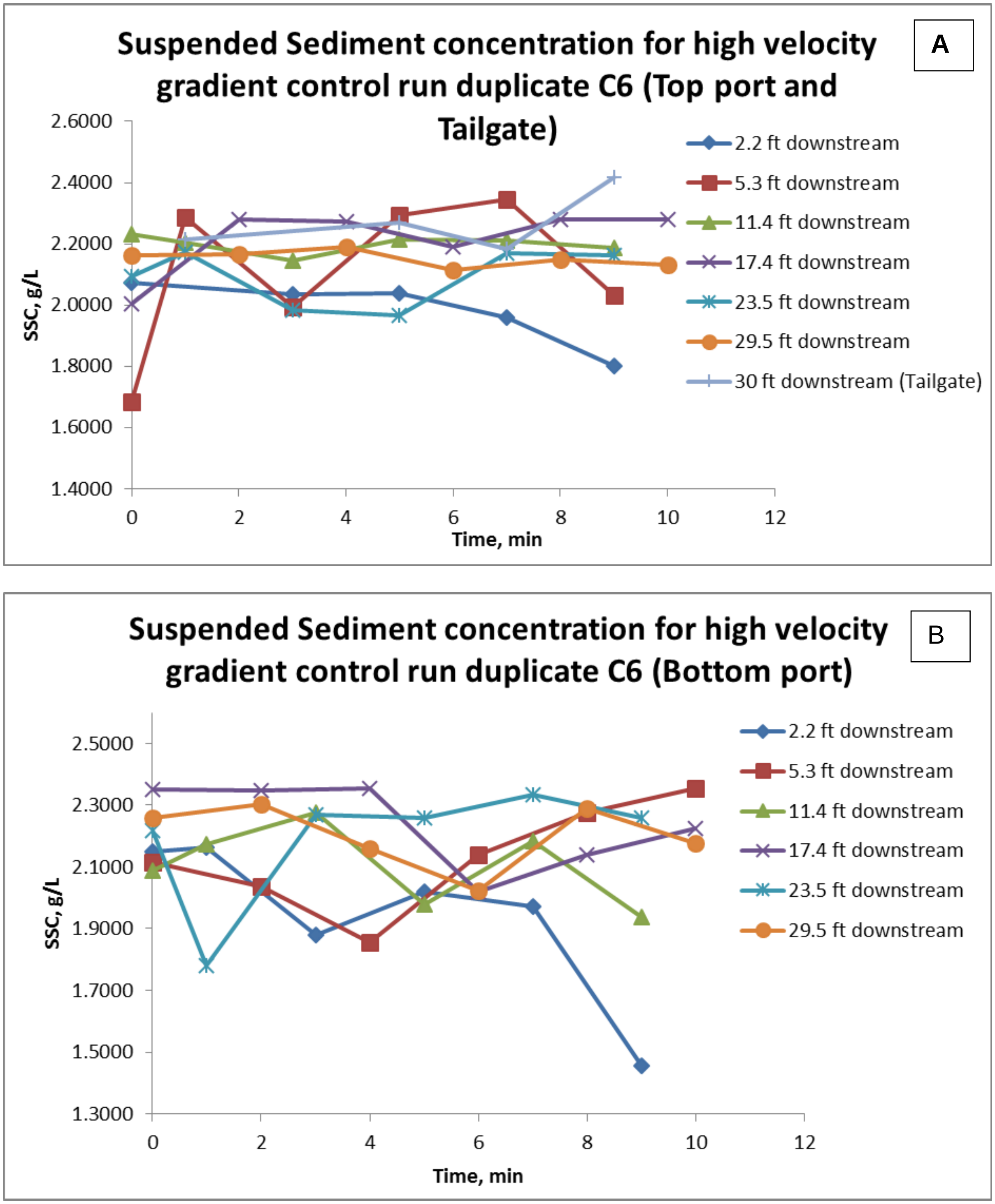


Figure 96. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

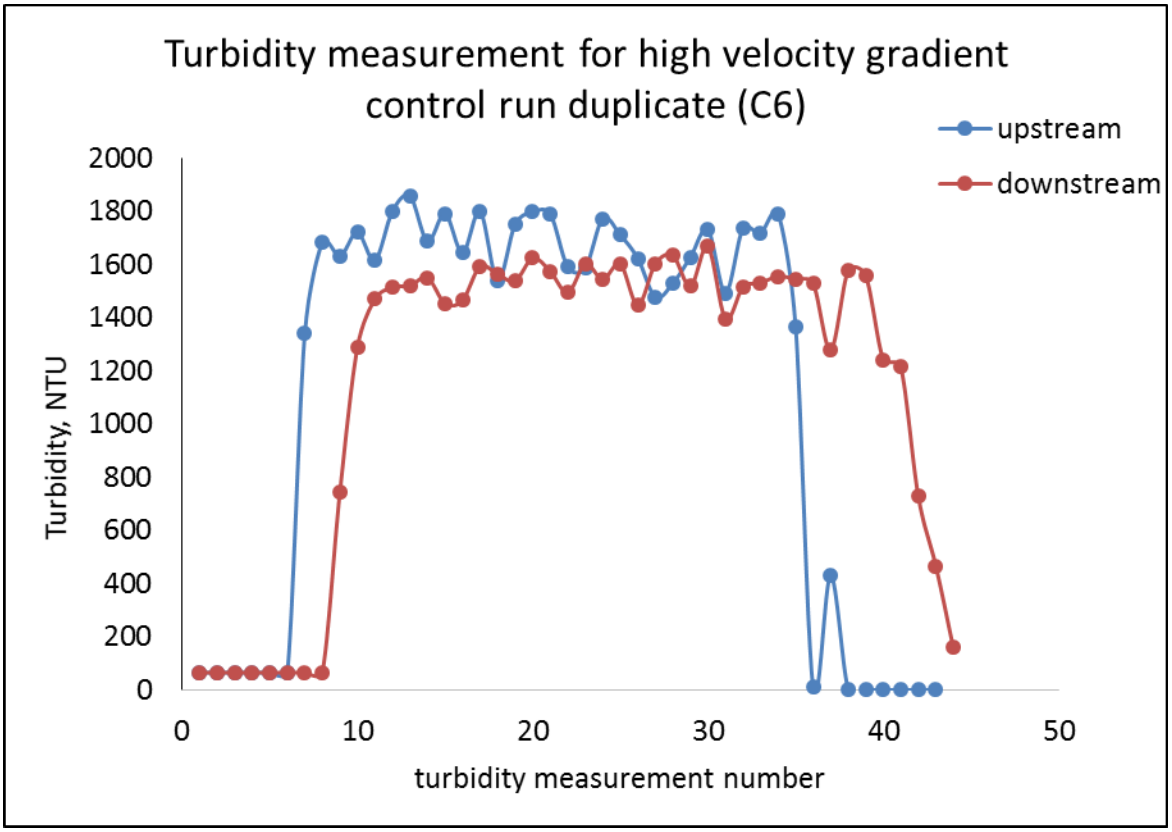


Figure 97. Upstream and downstream turbidity for high velocity gradient control run duplicate C6. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

Norge B Low Velocity Gradient Flocculation Run (F1)

The oscillating grid speed was set at 99 rpm. Tables 346 to 353 show the data related to this run, and Figure 98 shows the graph of the sediment concentration. Figure 99 shows the graph of the upstream and downstream turbidity.

Table 346. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3319	31.3857	26.8768	31.8795	0.5449	0.4938	2.1796	1.9752
2	26.2689	26.2663	26.8212	26.8178	0.5523	0.5515	2.2092	2.2060
3	26.3590	26.4030	26.8999	26.9798	0.5409	0.5768	2.1636	2.3072
4	26.4766	31.4792	27.0290	31.9571	0.5524	0.4779	2.2096	1.9116
5	26.2730	26.3343	26.8042	26.8906	0.5312	0.5563	2.1248	2.2252
6	26.3225	31.5600	26.8885	32.0364	0.5660	0.4764	2.2640	1.9056

Table 347. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2900	26.4318	26.8300	26.9231	0.5400	0.4913	2.1600	1.9652
2	31.4376	26.5151	31.8962	27.0199	0.4586	0.5048	1.8344	2.0192
3	26.3679	31.4222	26.8317	31.8623	0.4638	0.4401	1.8552	1.7604
4	26.4214	26.3034	26.9129	26.7640	0.4915	0.4606	1.9660	1.8424
5	26.4782	26.3285	26.9460	26.8025	0.4678	0.4740	1.8712	1.8960
6	26.2762	26.2790	26.7548	26.4544	0.4786	0.1754	1.9144	0.7016

Table 348. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 3 (‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3246	26.3251	26.8549	26.8196	0.5303	0.4945	2.1212	1.9780
2	31.2971	26.3202	31.7200	26.8355	0.4229	0.5153	1.6916	2.0612
3	26.2528	26.3248	26.7455	26.8426	0.4927	0.5178	1.9708	2.0712
4	26.4992	31.5489	26.9624	31.9858	0.4632	0.4369	1.8528	1.7476
5	26.2872	26.4763	26.7568	27.0256	0.4696	0.5493	1.8784	2.1972
6	26.4472	26.2890	26.9336	26.8030	0.4864	0.5140	1.9456	2.0560

Table 349. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 4 (‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2678	26.5085	26.6499	27.0066	0.3821	0.4981	1.5284	1.9924
2	26.3188	26.4102	26.5412	26.7572	0.2224	0.3470	0.8896	1.3880
3	31.4618	26.2725	31.6117	26.6649	0.1499	0.3924	0.5996	1.5696
4	26.2745	26.3907	26.5001	26.8057	0.2256	0.4150	0.9024	1.6600
5	26.4872	26.4051	26.7054	26.8264	0.2182	0.4213	0.8728	1.6852
6	26.3242	31.3927	26.5278	31.7661	0.2036	0.3734	0.8144	1.4936

Table 350. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 5 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.2897	26.3787	26.7553	26.9173	0.4656	0.5386	1.8624	2.1544
2	26.4000	26.4013	26.5809	26.6843	0.1809	0.2830	0.7236	1.1320
3	26.4041	26.3185	26.5539	26.4894	0.1498	0.1709	0.5992	0.6836
4	26.2983	26.3704	26.4280	26.5983	0.1297	0.2279	0.5188	0.9116
5	26.2910	26.3102	26.4443	26.4816	0.1533	0.1714	0.6132	0.6856
6	26.3216	26.3345	26.4845	26.5771	0.1629	0.2426	0.6516	0.9702

Table 351. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 6 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.3868	26.2902	26.8644	26.8329	0.4776	0.5427	1.9104	2.1708
2	26.2839	26.2827	26.4650	26.5453	0.1811	0.2626	0.7244	1.0504
3	26.2181	26.4072	26.4080	26.6585	0.1899	0.2513	0.7596	1.0052
4	26.4181	31.4792	26.6066	31.6978	0.1885	0.2186	0.7540	0.8744
5	26.4354	26.3342	26.6250	26.5867	0.1896	0.2525	0.7584	1.0100
6	26.2426	26.4287	26.4423	26.6393	0.1997	0.2106	0.7988	0.8424

Table 352. Suspended sediment concentration for low velocity gradient flocculation run F1 at tailgate ('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment Concentration g/L
1	26.4102	26.8342	0.4240	1.6960
2	26.2647	26.6908	0.4261	1.7044
3	26.2403	26.4463	0.2060	0.8240
4	26.4800	26.6417	0.1617	0.6468
5	26.3680	26.5072	0.1392	0.5568
6	26.2869	26.4889	0.2020	0.8080

Table 353. Mass of the sediment settled in the trays for low velocity gradient flocculation run F1.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	73.10	83.05	9.95
2	75.10	124.60	49.50
3	69.55	148.35	78.80
4	72.00	254.60	182.60
5	148.30	677.05	528.75
6	214.30	1085.70	871.40
7	139.95	653.30	513.35
8	148.35	395.65	247.30
9	143.55	283.30	139.75
10	139.60	220.95	81.35
11	144.05	215.65	71.60

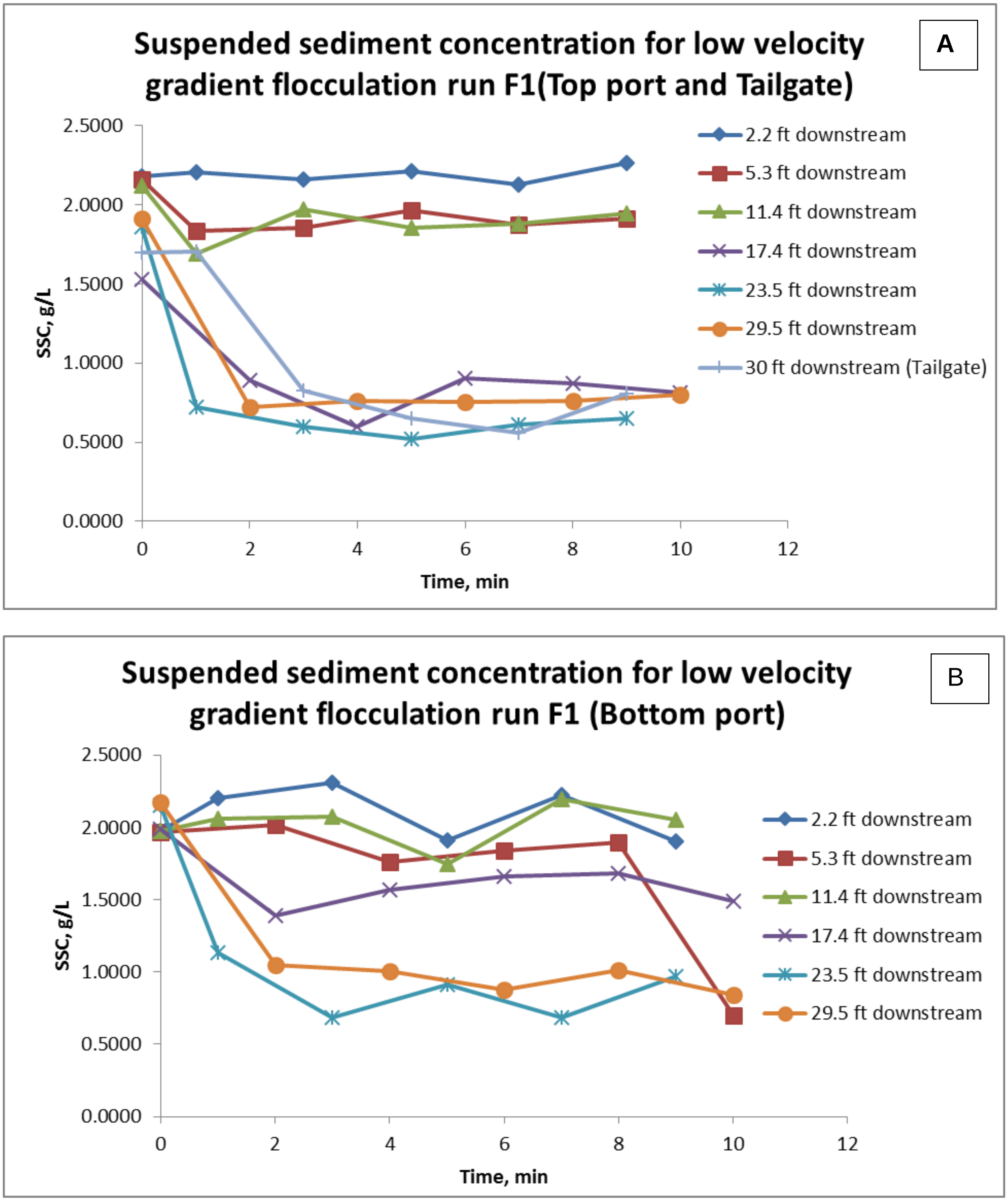


Figure 98. **Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was**

collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

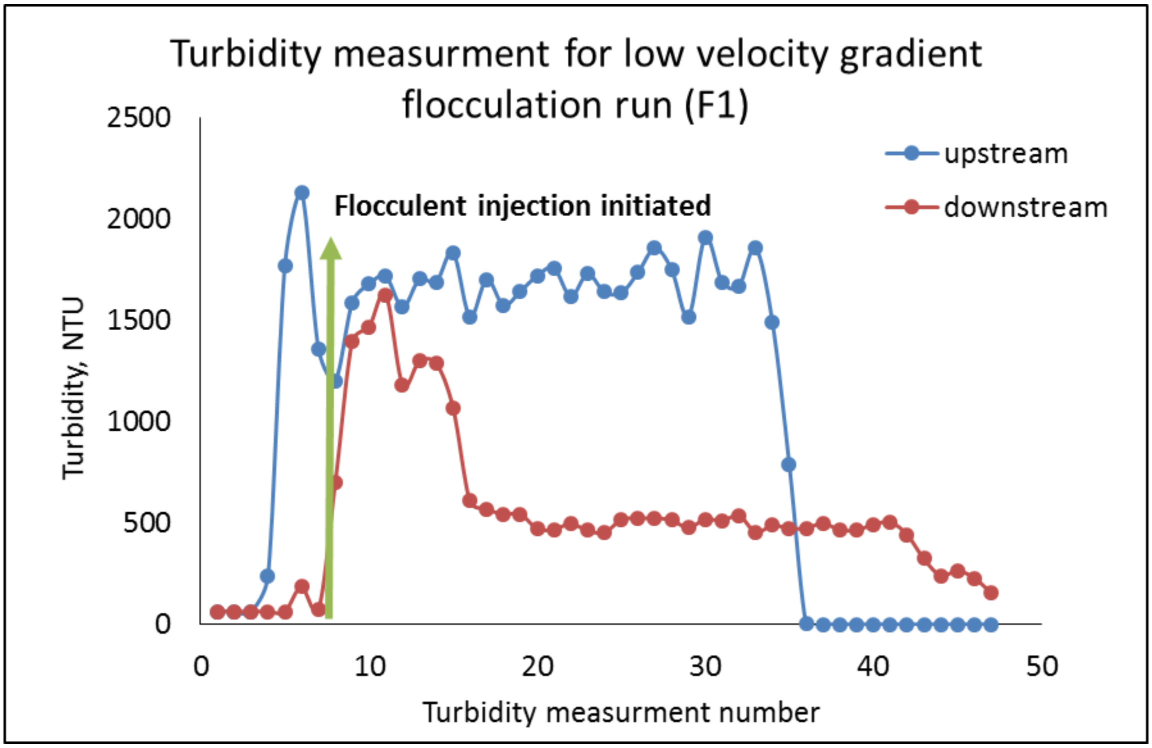


Figure 99. Upstream and downstream turbidity for low velocity gradient flocculation run F1. The turbidity measurement number indicates every 30-second time interval **after which the turbidity reading was recorded by the instrument.**

<u>Norge B High Velocity Gradient Flocculation Run (F2)</u>

The oscillating grid speed was set at 148 rpm. Tables 354 to 361 show the data related to this run, and Figure 100 shows the graph of the sediment concentration. Figure 101 shows the graph of the upstream and downstream turbidity.

Table 354. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	26.2557	26.3016	26.8014	26.8632	0.5457	0.5616	2.1828	2.2464
2	31.4891	26.3851	31.9765	26.9377	0.4874	0.5526	1.9496	2.2104
3	26.3965	31.1425	26.9254	31.6834	0.5289	0.5409	2.1156	2.1636
4	31.5504	26.3816	32.0502	26.8832	0.4998	0.5016	1.9992	2.0064
5	26.4261	26.4401	26.9550	26.9677	0.5289	0.5276	2.1156	2.1104
6	26.2997	26.2840	26.8116	26.7856	0.5119	0.5016	2.0476	2.0064

Table 355. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	26.4495	26.4369	26.9054	26.9609	0.4559	0.5240	1.8236	2.0960
2	26.4408	31.5464	26.9565	32.0108	0.5157	0.4644	2.0628	1.8576
3	26.2986	26.3121	26.8234	26.8230	0.5248	0.5109	2.0992	2.0436
4	26.2852	31.4929	26.8086	31.9970	0.5234	0.5041	2.0936	2.0164
5	31.1908	31.3577	31.6603	31.8571	0.4695	0.4994	1.8780	1.9976
6	31.4441	26.3755	31.9634	26.8058	0.5193	0.4303	2.0772	1.7212

Table 356. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 3(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3088	26.3352	26.8436	26.9062	0.5348	0.5710	2.1392	2.2840
2	26.1790	26.3727	26.6915	26.9121	0.5125	0.5394	2.0500	2.1576
3	26.4062	31.4841	26.8766	31.9968	0.4704	0.5127	1.8816	2.0508
4	31.3809	26.2621	31.9133	26.7460	0.5324	0.4839	2.1296	1.9356
5	31.1603	31.3762	31.6114	31.7680	0.4511	0.3918	1.8044	1.5672
6	31.3996	26.3925	31.8795	26.9208	0.4799	0.5283	1.9196	2.1132

Table 357. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 4(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3085	31.4023	26.8521	31.9288	0.5436	0.5265	2.1744	2.1060
2	26.4117	31.2850	26.6848	31.6434	0.2731	0.3584	1.0924	1.4336
3	26.3952	26.2715	26.6565	26.6920	0.2613	0.4205	1.0452	1.6820
4	26.2874	26.2742	26.5446	26.7172	0.2572	0.4430	1.0288	1.7720
5	26.1449	26.2544	26.4241	26.7257	0.2792	0.4713	1.1168	1.8852
6	26.3041	31.4459	26.5701	31.8976	0.2660	0.4517	1.0640	1.8068

Table 358. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	31.4295	26.3918	31.9482	26.9309	0.5187	0.5391	2.0748	2.1564
2	26.2403	26.2941	26.5005	26.7411	0.2602	0.4470	1.0408	1.7880
3	31.2071	31.5313	31.4075	31.7037	0.2004	0.1724	0.8016	0.6896
4	26.4285	26.1990	26.6163	26.4980	0.1878	0.2990	0.7512	1.1960
5	31.4373	31.4216	31.5667	31.6785	0.1294	0.2569	0.5176	1.0276
6	31.3950	31.4020	31.5767	31.6874	0.1817	0.2854	0.7268	1.1416

Table 359. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 6('-'indicates No data available).

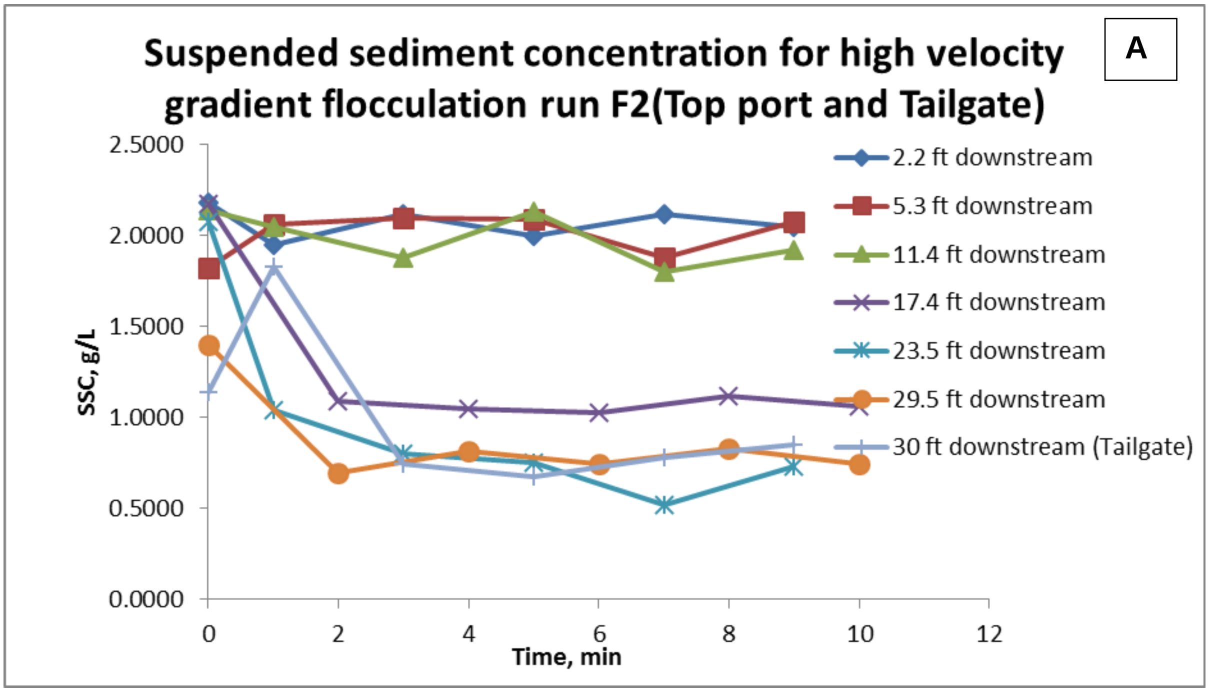
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	31.3153	26.4325	31.6653	26.9838	0.3500	0.5513	1.4000	2.2052
2	31.2538	26.4107	31.4273	26.7426	0.1735	0.3319	0.6940	1.3276
3	31.1971	26.4110	31.4010	26.6551	0.2039	0.2441	0.8156	0.9764
4	26.3936	26.3831	26.5789	26.6268	0.1853	0.2437	0.7412	0.9748
5	26.3978	31.3500	26.6045	31.5990	0.2067	0.2490	0.8268	0.9960
6	31.5070	26.3646	31.6923	26.5900	0.1853	0.2254	0.7412	0.9016

Table 360. Suspended sediment concentration for high velocity gradient flocculation run F2 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3025	26.5872	0.2847	1.1388
2	26.4332	26.8903	0.4571	1.8284
3	26.4198	26.6057	0.1859	0.7436
4	26.2658	26.4336	0.1678	0.6712
5	26.3421	26.5370	0.1949	0.7796
6	31.3973	31.6091	0.2118	0.8472

Table 361. Mass of the sediment settled in the trays for high velocity gradient flocculation run F2

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.3	444.8	11.50
2	759.5	823.85	64.35
3	759.75	840.15	80.40
4	759.5	907.15	147.65
5	1518.9	1943.7	424.80
6	1520.25	2306.7	786.45
7	1520.3	2142.55	622.25
8	1519.45	1844.3	324.85
9	1518.95	1713.1	194.15
10	1518.8	1645.9	127.10
11	1519.8	1610.85	91.05



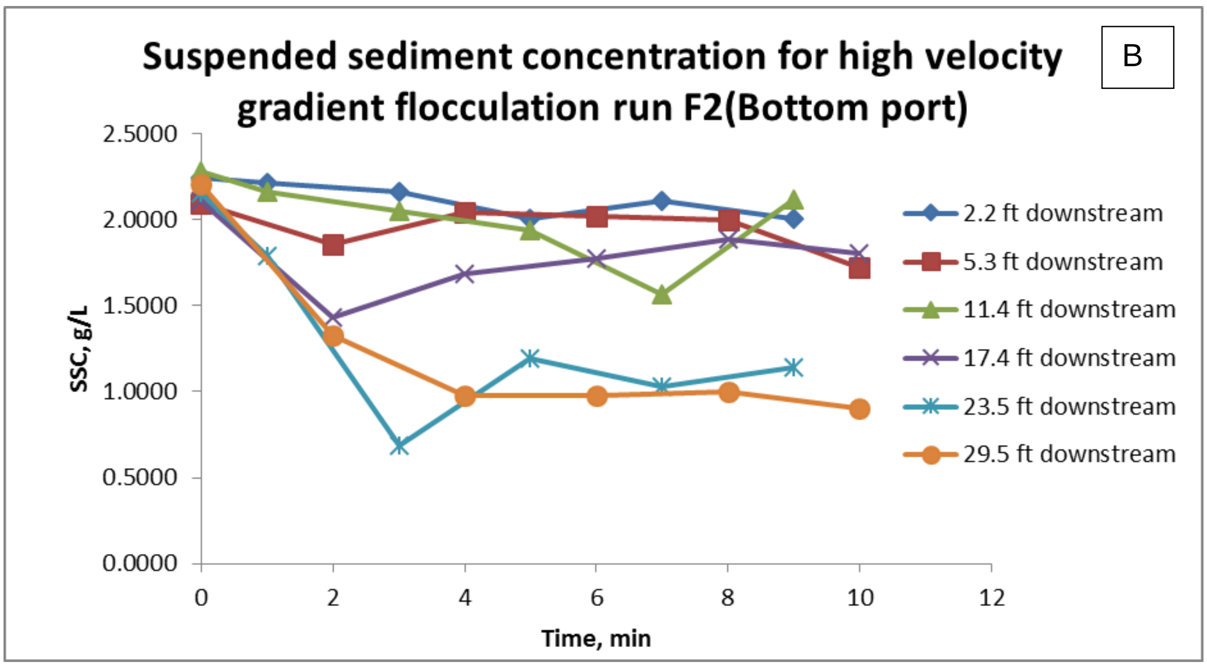


Figure 100. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

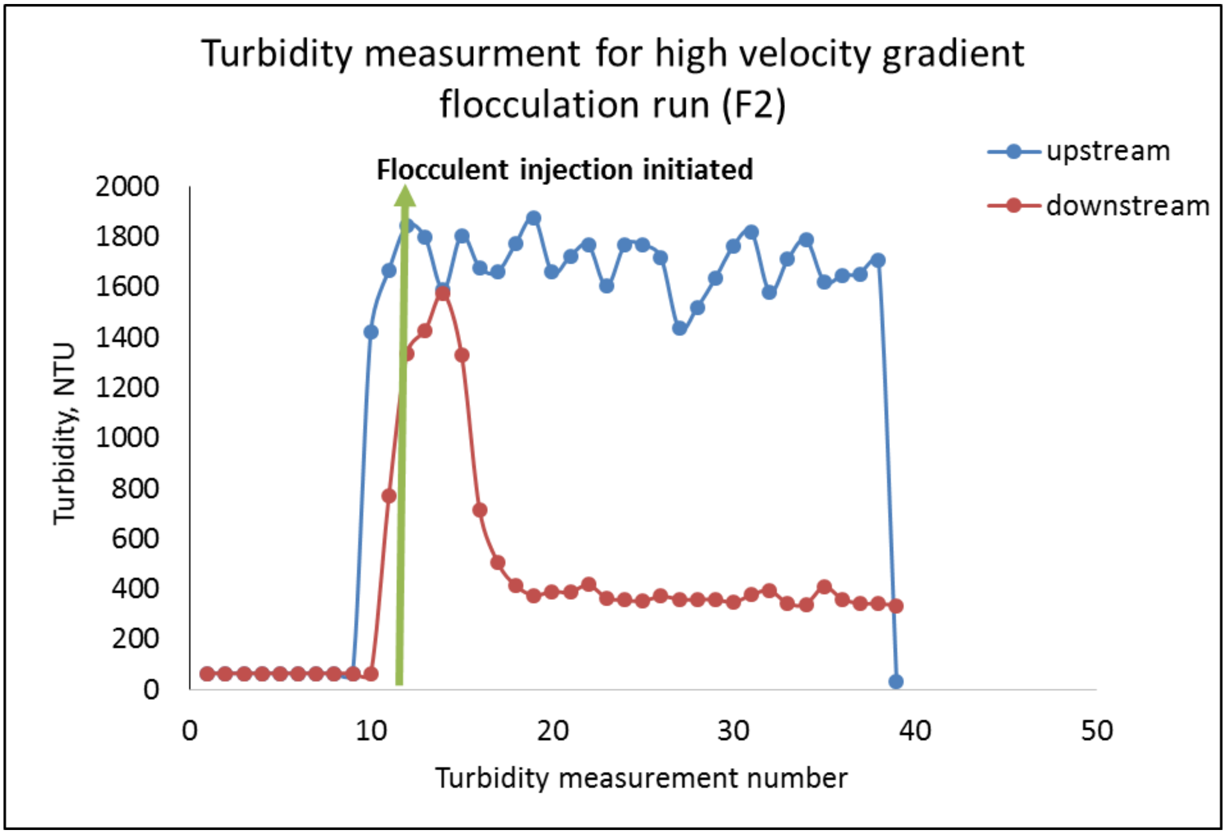


Figure 101. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

<u>Norge B Low Velocity Gradient Flocculation Run Duplicate (F3)</u>

The oscillating grid speed was set at 99 rpm. Tables 362 to 369 show the data related to this run, and Figure 102 shows the graph of the sediment concentration. Figure 103 shows the graph of the upstream and downstream turbidity.

Table 362. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4363	26.3543	26.9533	26.8802	0.5170	0.5259	2.0680	2.1036
2	26.2735	26.2728	26.7915	26.8037	0.5180	0.5309	2.0720	2.1236
3	26.2627	31.4062	26.7972	31.9259	0.5345	0.5197	2.1380	2.0788
4	26.3497	26.4178	26.9134	26.9453	0.5637	0.5275	2.2548	2.1100
5	26.2466	31.3652	26.7994	31.8991	0.5528	0.5339	2.2112	2.1356
6	31.3658	26.3840	31.8973	26.9017	0.5315	0.5177	2.1260	2.0708

Table 363. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 2('-'indicates No data available).

	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3704	31.3867	31.8791	31.8990	0.5087	0.5123	2.0348	2.0492
2	31.4902	31.3831	31.9895	31.8699	0.4993	0.4868	1.9972	1.9472
3	31.3728	26.4330	31.8679	26.9857	0.4951	0.5527	1.9804	2.2108
4	26.2905	26.3701	26.7839	26.8804	0.4934	0.5103	1.9736	2.0412
5	26.2738	31.4544	26.8792	31.9414	0.6054	0.4870	2.4216	1.9480
6	31.4696	26.2203	32.0231	26.7442	0.5535	0.5239	2.2140	2.0956

Table 364. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4111	26.3638	26.8616	26.8992	0.4505	0.5354	1.8020	2.1416
2	26.4005	31.3728	26.9544	31.8889	0.5539	0.5161	2.2156	2.0644
3	31.4315	26.3850	31.9687	26.8860	0.5372	0.5010	2.1488	2.0040
4	26.2796	26.4913	26.7785	27.0161	0.4989	0.5248	1.9956	2.0992
5	26.3880	26.2998	26.9077	26.8743	0.5197	0.5745	2.0788	2.2980
6	26.3725	31.4148	26.8321	31.9392	0.4596	0.5244	1.8384	2.0976

Table 365. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3617	26.2920	26.8350	26.8018	0.4733	0.5098	1.8932	2.0392
2	26.4976	31.3987	26.6702	31.7180	0.1726	0.3193	0.6904	1.2772
3	26.3418	26.3343	26.5099	26.6481	0.1681	0.3138	0.6724	1.2552
4	26.3062	31.3564	26.4850	31.6778	0.1788	0.3214	0.7152	1.2856
5	26.4117	26.2540	26.6052	26.5853	0.1935	0.3313	0.7740	1.3252
6	26.4164	26.4993	26.6244	26.8037	0.2080	0.3044	0.8320	1.2176

Table 366. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3858	26.4898	26.8797	26.9944	0.4939	0.5046	1.9756	2.0184
2	26.4202	31.3759	26.6470	31.7661	0.2268	0.3902	0.9072	1.5608
3	31.3699	26.3735	31.5175	26.5828	0.1476	0.2093	0.5904	0.8372
4	31.3637	26.4117	31.5173	26.6296	0.1536	0.2179	0.6144	0.8716
5	26.3875	26.3840	26.5430	26.6012	0.1555	0.2172	0.6220	0.8688
6	26.2372	26.2764	26.3928	26.5051	0.1556	0.2287	0.6224	0.9148

Table 367. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 6('-'indicates No data available).

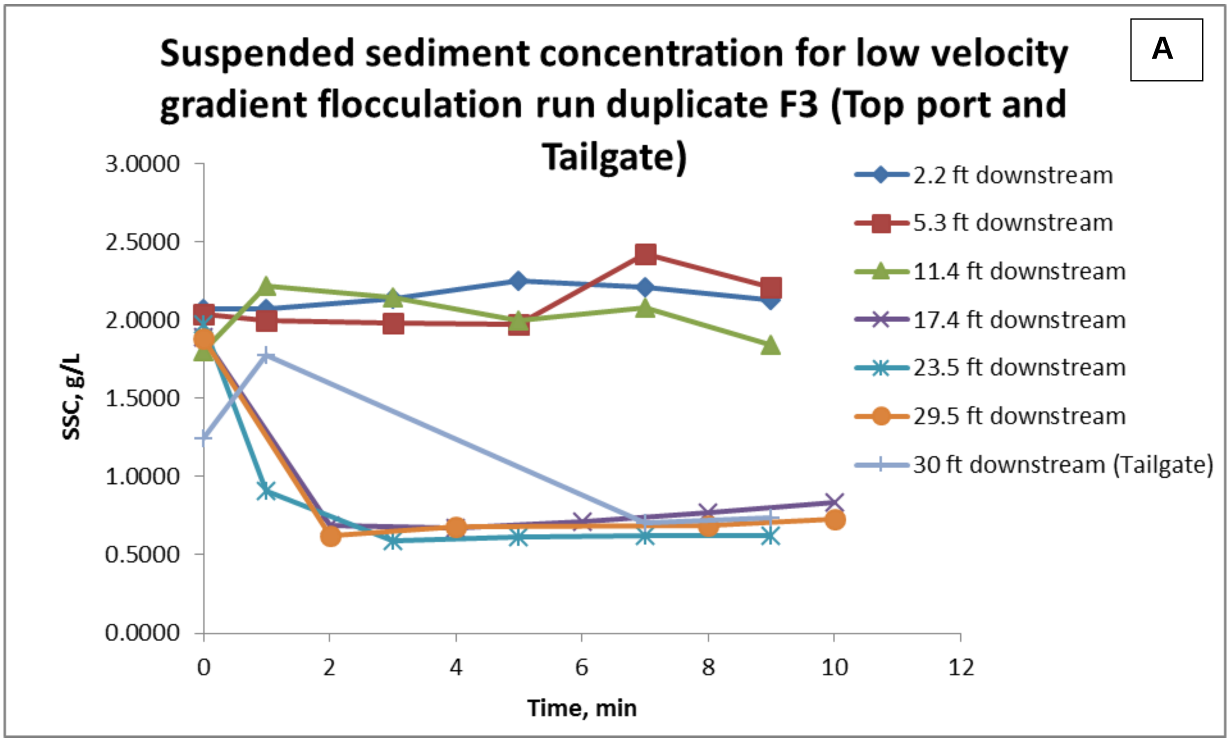
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4522	26.2973	26.9235	26.8003	0.4713	0.5030	1.8852	2.0120
2	26.4986	26.3215	26.6538	26.5273	0.1552	0.2058	0.6208	0.8232
3	26.2585	26.5470	26.4283	26.7590	0.1698	0.2120	0.6792	0.8480
4	26.2560	31.3955	26.4285	31.5981	0.1725	0.2026	0.6900	0.8104
5	26.3938	26.2931	26.5651	26.5063	0.1713	0.2132	0.6852	0.8528
6	26.3986	31.3265	26.5807	31.5332	0.1821	0.2067	0.7284	0.8268

Table 368. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.4735	26.7847	0.3112	1.2448
2	26.4444	26.8895	0.4451	1.7804
3	26.3879	26.5653	0.1774	0.7096
4	26.4333	26.6177	0.1844	0.7376
5	26.2572	26.4329	0.1757	0.7028
6	26.3705	26.5542	0.1837	0.7348

Table 369. Mass of the sediment settled in the trays for low velocity gradient flocculation run duplicate F3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.60	401.60	9.00
2	759.30	800.20	40.90
3	758.95	820.35	61.40
4	70.70	219.65	148.95
5	142.45	727.15	584.70
6	220.30	1274.85	1054.55
7	147.75	633.25	485.50
8	66.85	219.90	153.05
9	146.55	226.45	79.90
10	137.85	206.05	68.20
11	141.60	166.75	25.15



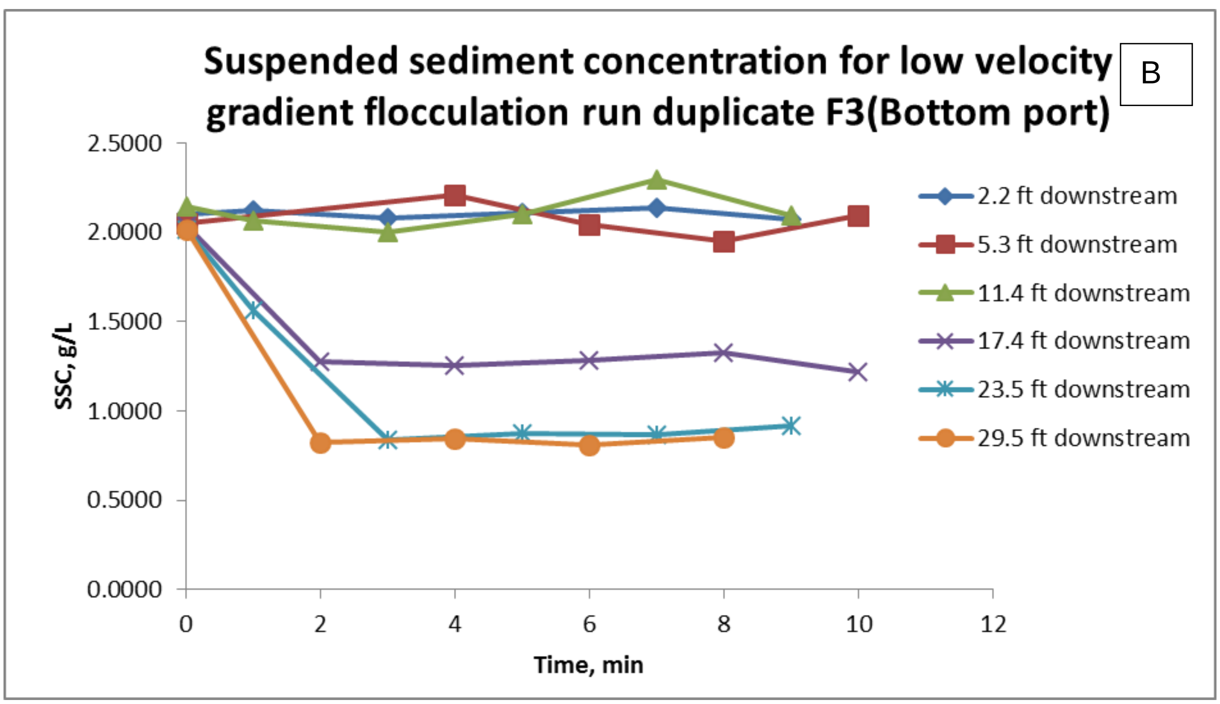


Figure 102. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

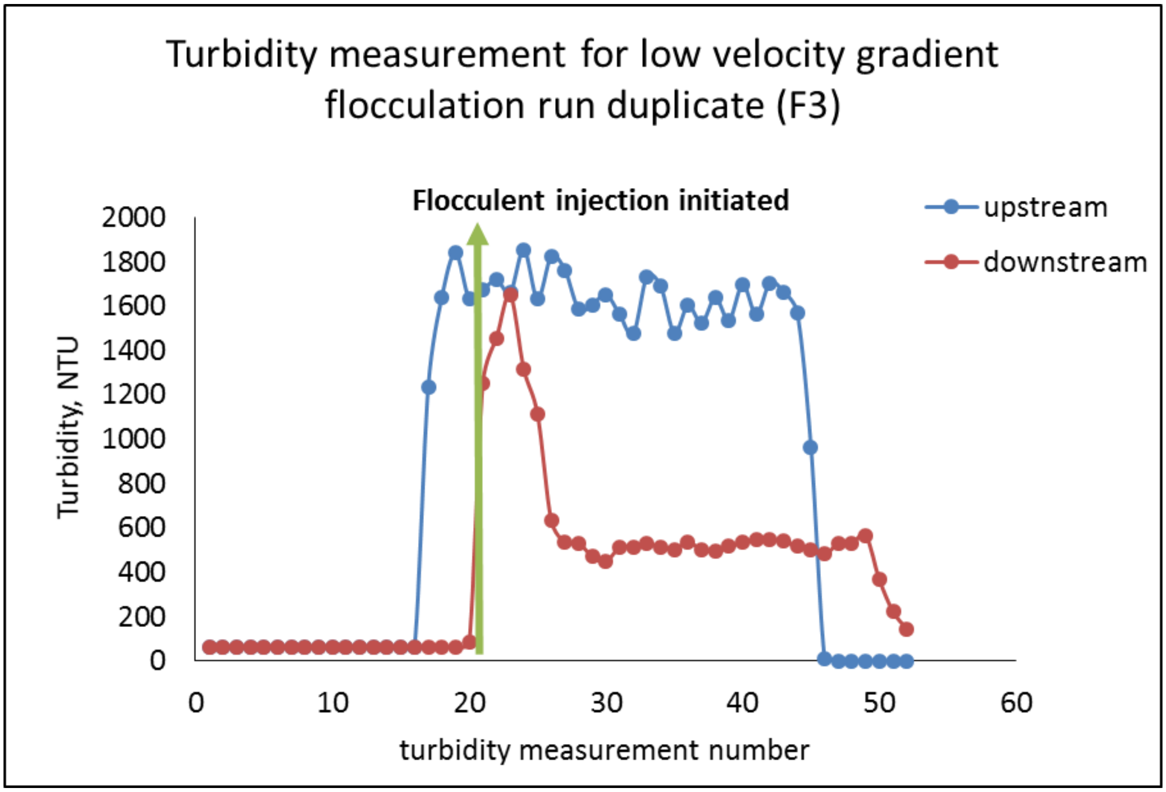


Figure 103. Upstream and downstream turbidity for low velocity gradient flocculation run duplicate F3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Norge B High Velocity Gradient Flocculation Run Duplicate (F4)</u>

The oscillating grid speed was set at 148 rpm. Tables 370 to 377 show the data related to this run, and Figure 104 shows the graph of the sediment concentration. Figure 105 shows the graph of the upstream and downstream turbidity.

Table 370. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 1(‘-‘indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3546	26.4127	26.8419	26.9053	0.4873	0.4926	1.9492	1.9704
2	26.2589	31.5642	26.7300	32.0259	0.4711	0.4617	1.8844	1.8468
3	26.3255	26.3082	26.6594	26.8005	0.3339	0.4923	1.3356	1.9692
4	26.3106	26.5097	26.7933	26.8589	0.4827	0.3492	1.9308	1.3968
5	26.6933	31.8008	26.9827	31.8547	0.2894	0.0539	1.1576	0.2156
6	31.3670	31.4817	31.8195	31.9725	0.4525	0.4908	1.8100	1.9632

Table 371. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 2(‘-‘indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3127	31.4027	26.7300	31.8855	0.4173	0.4828	1.6692	1.9312
2	26.2569	31.2932	26.7361	31.7058	0.4792	0.4126	1.9168	1.6504
3	26.3771	26.3470	26.8502	26.8250	0.4731	0.4780	1.8924	1.9120
4	26.4420	26.3115	26.9164	26.7574	0.4744	0.4459	1.8976	1.7836
5	26.3166	26.3240	26.7862	26.7676	0.4696	0.4436	1.8784	1.7744
6	26.4190	26.3944	26.8644	26.8444	0.4454	0.4500	1.7816	1.8000

Table 372. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 3('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4118	26.2737	26.8770	26.8066	0.4652	0.5329	1.8608	2.1316
2	26.4210	31.4081	26.8778	31.8753	0.4568	0.4672	1.8272	1.8688
3	26.4785	26.4691	26.9218	26.9497	0.4433	0.4806	1.7732	1.9224
4	31.3573	26.3362	31.7982	26.8143	0.4409	0.4781	1.7636	1.9124
5	31.3818	26.4387	31.8179	26.8955	0.4361	0.4568	1.7444	1.8272
6	31.6416	26.2211	31.8238	26.6799	0.1822	0.4588	0.7288	1.8352

Table 373. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 4('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2736	31.5571	26.7555	31.9495	0.4819	0.3924	1.9276	1.5696
2	26.2480	26.2753	26.4843	26.6818	0.2363	0.4065	0.9452	1.6260
3	26.3687	26.4114	26.6261	26.8311	0.2574	0.4197	1.0296	1.6788
4	26.5133	26.3479	26.6495	26.7255	0.1362	0.3776	0.5448	1.5104
5	26.3102	31.4565	26.5147	31.8656	0.2045	0.4091	0.8180	1.6364
6	26.3173	26.3879	26.5851	26.8076	0.2678	0.4197	1.0712	1.6788

Table 374. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 5('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3081	26.4400	26.7832	26.9545	0.4751	0.5145	1.9004	2.0580
2	26.2403	26.2835	26.4721	26.6445	0.2318	0.3610	0.9272	1.4440
3	26.2676	26.2761	26.4596	26.5577	0.1920	0.2816	0.7680	1.1264
4	31.4110	26.2808	31.5636	26.5553	0.1526	0.2745	0.6104	1.0980
5	26.3988	31.4579	26.5611	31.6934	0.1623	0.2355	0.6492	0.9420
6	26.2757	26.2837	26.4572	26.5549	0.1815	0.2712	0.7260	1.0848

Table 375. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 6('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3461	26.4469	26.7714	26.9406	0.4253	0.4937	1.7012	1.9748
2	26.4814	26.2733	26.6867	26.5713	0.2053	0.2980	0.8212	1.1920
3	26.3841	26.3980	26.5854	26.6374	0.2013	0.2394	0.8052	0.9576
4	31.3817	31.1409	31.5962	31.3755	0.2145	0.2346	0.8580	0.9384
5	26.3884	31.5441	26.5785	31.7729	0.1901	0.2288	0.7604	0.9152
6	26.4364	26.3277	26.6240	26.5681	0.1876	0.2404	0.7504	0.9616

Table 376. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at tailgate('-'indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.2894	26.4779	0.1885	0.7540
2	26.3988	26.8474	0.4486	1.7944
3	26.3501	26.5438	0.1937	0.7748
4	26.4434	26.4486	0.0052	0.0208
5	26.5626	26.6309	0.0683	0.2732
6	26.4752	26.6671	0.1919	0.7676

Table 377. Mass of the sediment settled in the trays for high velocity gradient flocculation run duplicate F4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)
1	72.70	84.10	11.40
2	74.40	128.35	53.95
3	69.05	123.50	54.45
4	71.20	150.40	79.20
5	147.85	255.35	107.50
6	139.30	546.20	406.90
7	138.90	652.60	513.70
8	147.75	494.35	346.60
9	142.90	345.80	202.90
10	138.85	272.70	133.85
11	143.75	239.30	95.55

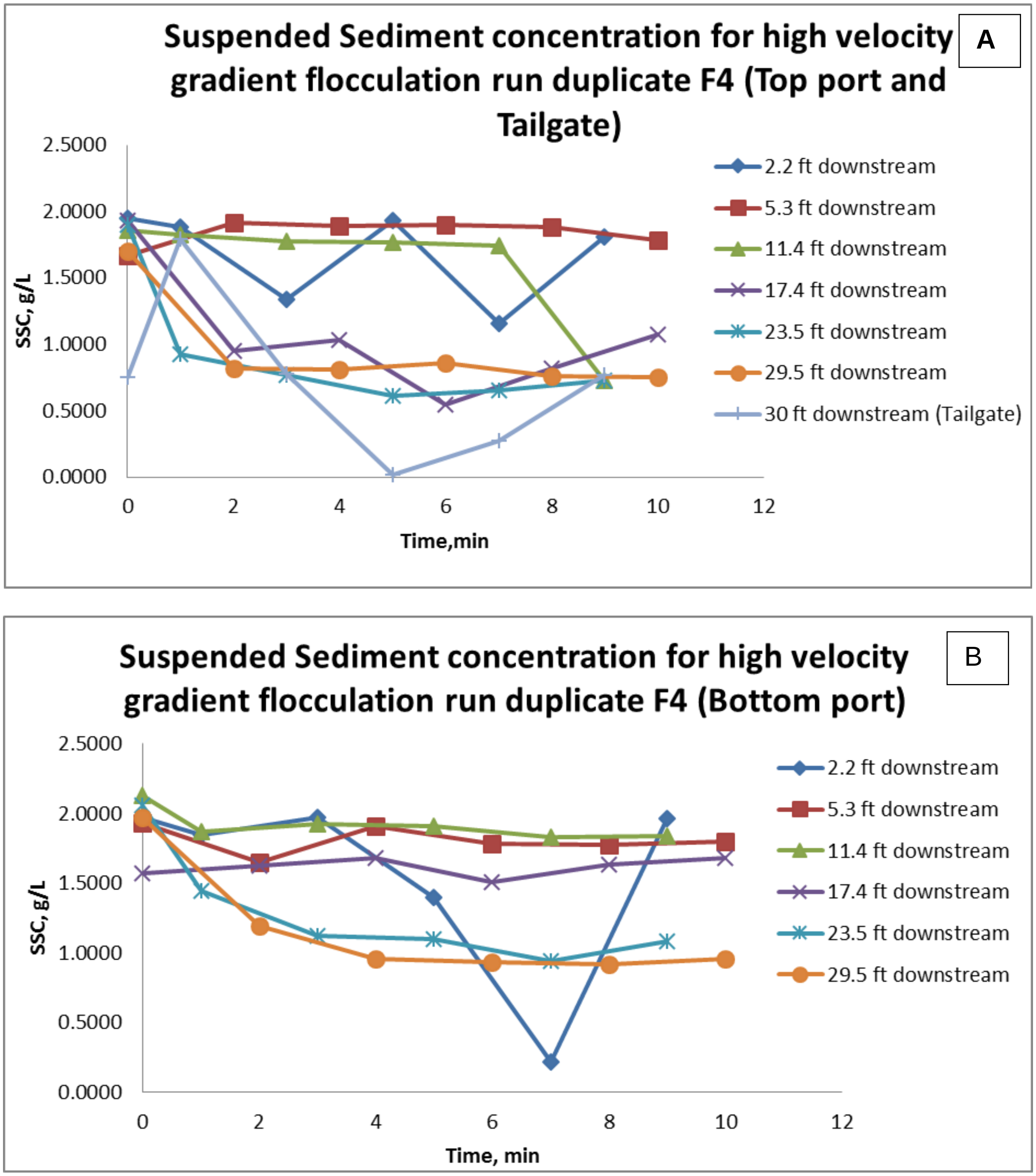


Figure 104: **Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.**

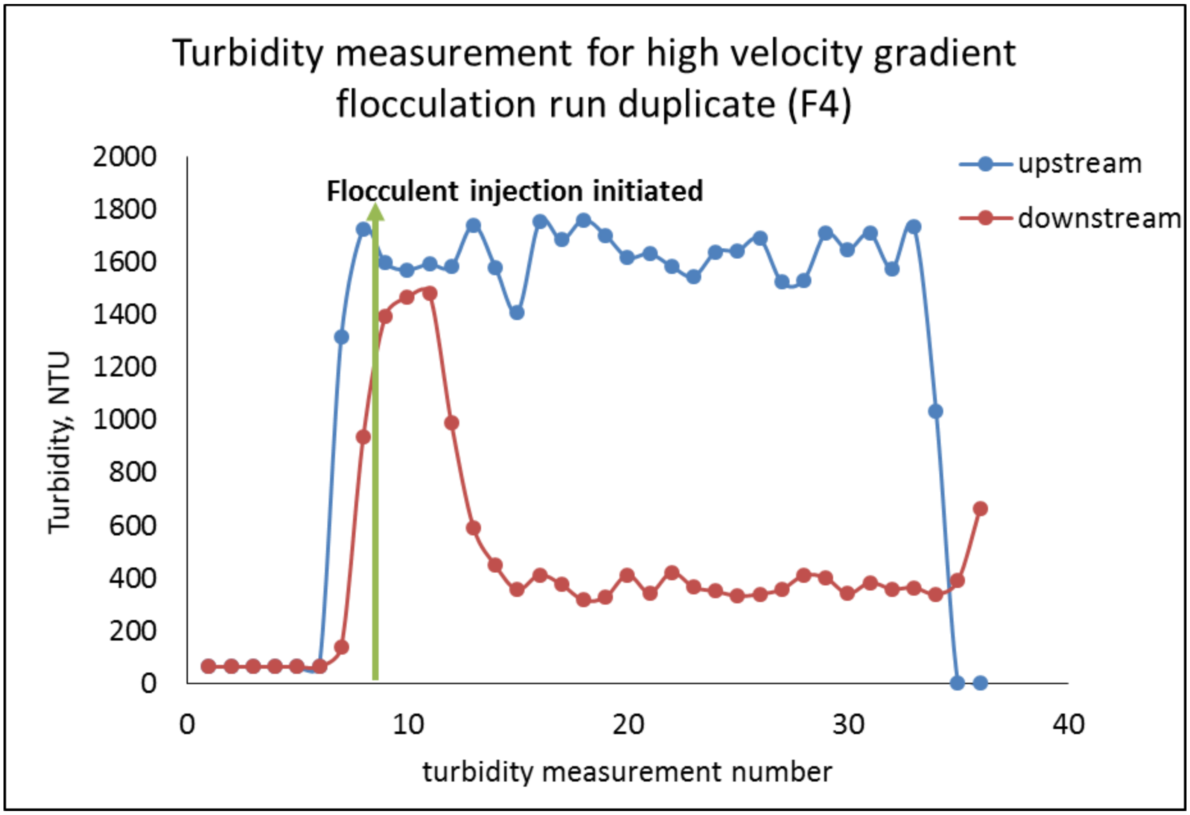


Figure 105. Upstream and downstream turbidity for high velocity gradient flocculation run duplicate F4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Norge B Low Velocity Gradient Flocculation Run Triplicate (F5)</u>

The oscillating grid speed was set at 99 rpm. Tables 378 to 385 show the data related to this run, and Figure 106 shows the graph of the sediment concentration. Figure 107 shows the graph of the upstream and downstream turbidity.

Table 378: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4567	31.5117	31.9622	32.0086	0.5055	0.4969	2.0220	1.9876
2	31.5025	26.4107	31.9828	26.9088	0.4803	0.4981	1.9212	1.9924
3	26.4000	31.4624	26.9169	31.9640	0.5169	0.5016	2.0676	2.0064
4	26.3603	31.5440	26.8733	32.0006	0.5130	0.4566	2.0520	1.8264
5	26.3732	31.5697	26.8328	32.0145	0.4596	0.4448	1.8384	1.7792
6	26.3307	31.4652	26.8390	31.9158	0.5083	0.4506	2.0332	1.8024

Table 379: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2964	26.3428	26.7883	26.8682	0.4919	0.5254	1.9676	2.1016
2	31.2692	26.4166	-	-	-	-	-	-
3	26.2737	26.3048	26.8084	26.8518	0.5347	0.5470	2.1388	2.1880
4	26.4442	26.3347	26.9561	26.8952	0.5119	0.5605	2.0476	2.2420
5	31.5082	26.2780	31.9977	26.8038	0.4895	0.5258	1.9580	2.1032
6	26.3829	26.4129	26.8692	26.9361	0.4863	0.5232	1.9452	2.0928

Table 380: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2430	31.5642	31.7898	32.0845	0.5468	0.5203	2.1872	2.0812
2	31.5210	31.1789	32.0185	31.6789	0.4975	0.5000	1.9900	2.0000
3	26.4966	31.3935	27.0151	31.9031	0.5185	0.5096	2.0740	2.0384
4	26.2962	31.4215	26.8307	31.8979	0.5345	0.4764	2.1380	1.9056
5	26.2459	26.3000	26.7872	26.8297	0.5413	0.5297	2.1652	2.1188
6	26.4187	31.3951	26.9516	31.9303	0.5329	0.5352	2.1316	2.1408

Table 381: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4460	31.5552	26.9203	32.0665	0.4743	0.5113	1.8972	2.0452
2	26.3344	31.4681	26.5962	31.8944	0.2618	0.4263	1.0472	1.7052
3	26.2487	31.4163	26.5119	31.8386	0.2632	0.4223	1.0528	1.6892
4	31.4358	26.2086	31.7062	26.6593	0.2704	0.4507	1.0816	1.8028
5	26.3063	31.4847	26.5913	31.9283	0.2850	0.4436	1.1400	1.7744
6	26.2775	31.2618	26.5708	31.6777	0.2933	0.4159	1.1732	1.6636

Table 382: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2990	31.4787	26.8192	31.9624	0.5202	0.4837	2.0808	1.9348
2	31.4400	26.2549	31.6781	26.6465	0.2381	0.3916	0.9524	1.5664
3	26.3981	26.3920	26.6207	26.6628	0.2226	0.2708	0.8904	1.0832
4	26.2812	31.4068	26.5366	31.6577	0.2554	0.2509	1.0216	1.0036
5	26.3573	26.3634	26.5986	26.6011	0.2413	0.2377	0.9652	0.9508
6	31.2244	26.4174	31.4507	26.7049	0.2263	0.2875	0.9052	1.1500

Table 383: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 6('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4869	26.2365	32.0003	26.5466	0.5134	0.3101	2.0536	1.2404
2	26.4651	31.1803	26.7258	31.4937	0.2607	0.3134	1.0428	1.2536
3	26.2741	26.2731	26.5127	26.5593	0.2386	0.2862	0.9544	1.1448
4	26.3022	31.3846	26.5438	31.6561	0.2416	0.2715	0.9664	1.0860
5	26.3350	26.5046	26.5904	26.7887	0.2554	0.2841	1.0216	1.1364
6	26.3125	26.3153	26.5221	26.6028	0.2096	0.2875	0.8384	1.1500

Table 384: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at tailgate (‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.2609	26.6403	0.3794	1.5176
2	31.5438	32.0346	0.4908	1.9632
3	26.4739	26.7410	0.2671	1.0684
4	26.2760	26.5444	0.2684	1.0736
5	31.3616	31.6118	0.2502	1.0008
6	31.4227	31.6861	0.2634	1.0536

Table 385: Mass of the sediment settled in the trays for low velocity gradient flocculation run triplicate F5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	435.10	439.50	4.40
2	74.50	109.45	34.95
3	759.20	806.75	47.55
4	759.75	836.20	76.45
5	1517.50	1825.10	307.60
6	2278.45	2976.15	697.70
7	1519.90	2026.85	506.95
8	1518.20	1718.10	199.90
9	759.10	839.00	79.90
10	1517.90	1573.35	55.45
11	1519.25	1560.10	40.85

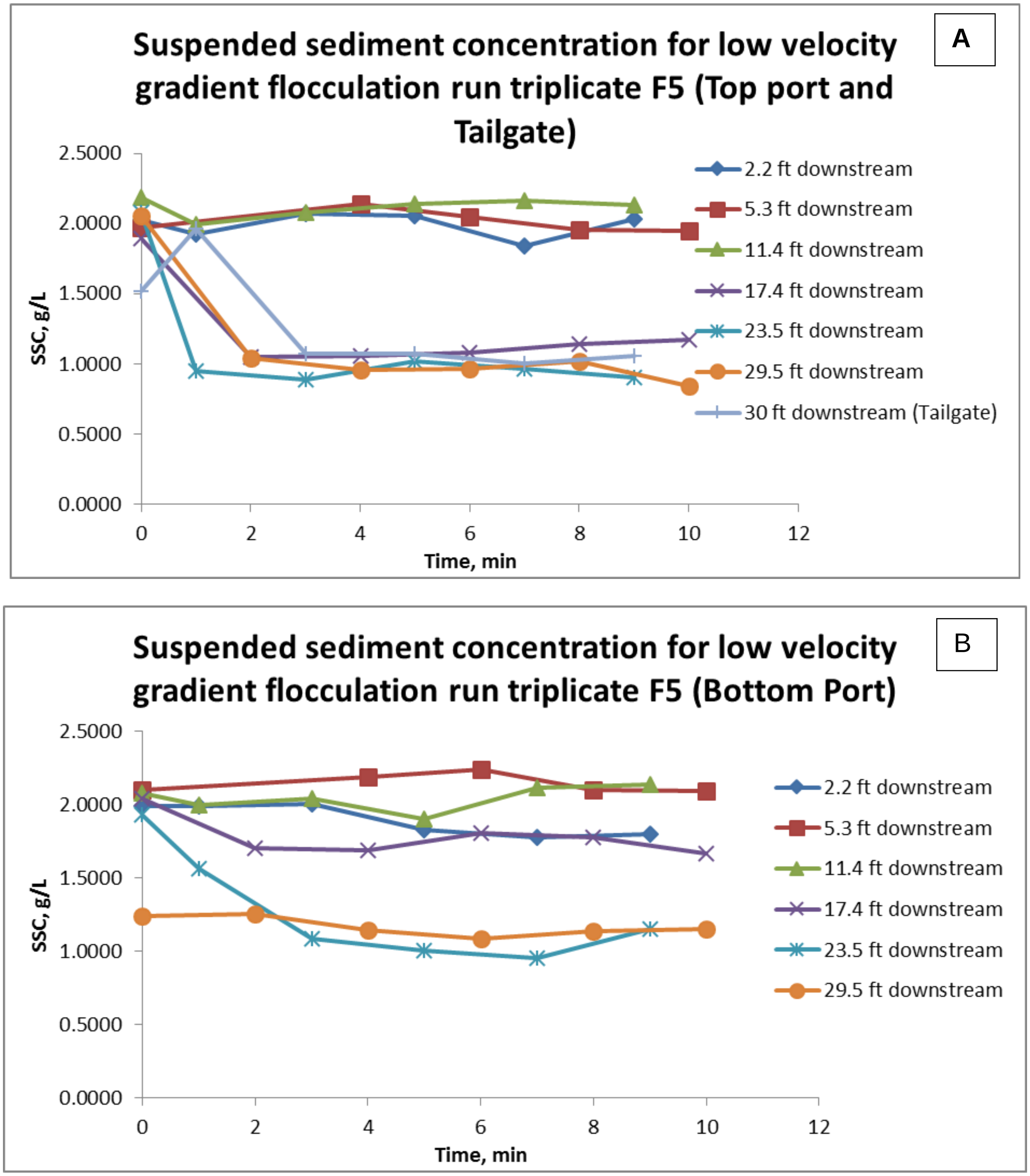


Figure 106: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

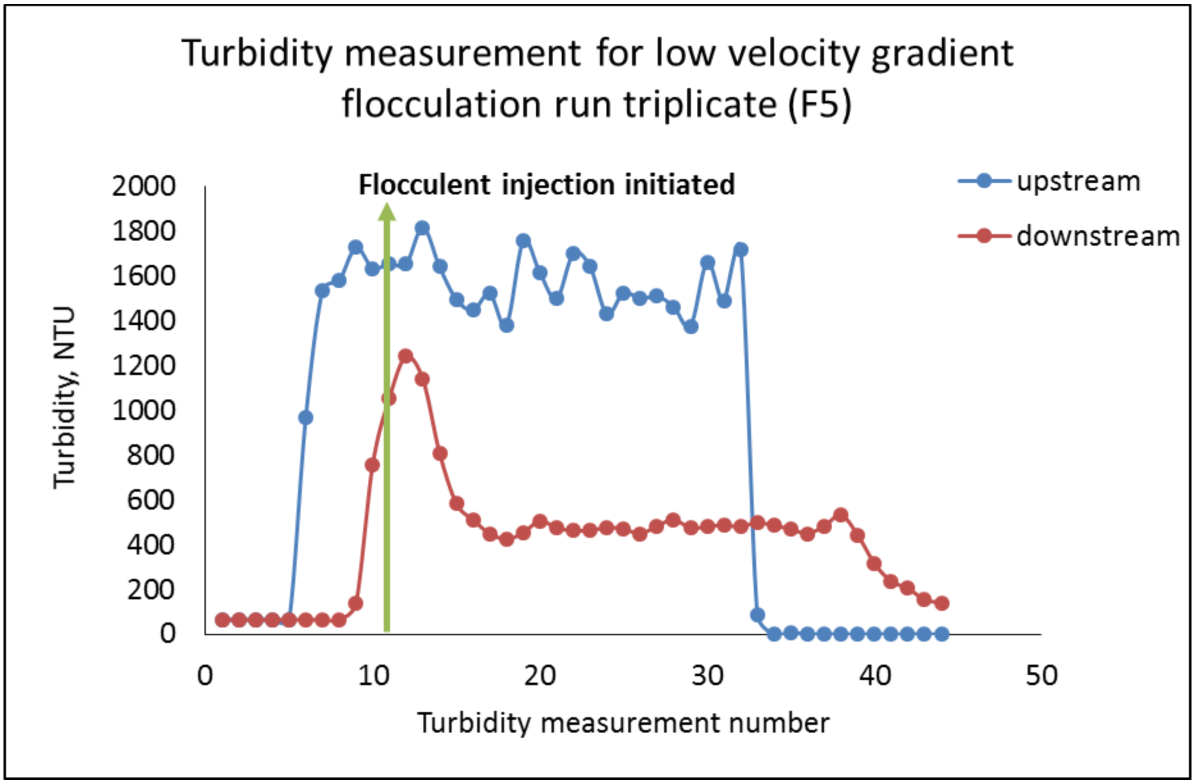


Figure 107. Upstream and downstream turbidity for low velocity gradient flocculation run triplicate F5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Norge B High Velocity Gradient Flocculation Run Triplicate (F6)</u>

The oscillating grid speed was set at 148 rpm. Tables 386 to 393 show the data related to this run, and Figure 108 shows the graph of the sediment concentration. Figure 109 shows the graph of the upstream and downstream turbidity. Figure 110 below summarizes the trapping efficiencies for the Norge B soil and Table 394 shows the values of the stickiness coefficient obtained.

Table 386. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2819	31.2255	26.7824	31.7210	0.5005	0.4955	2.0020	1.9820
2	26.4836	31.4072	26.9927	31.9170	0.5091	0.5098	2.0364	2.0392
3	31.5057	26.4091	31.9948	26.9090	0.4891	0.4999	1.9564	1.9996
4	31.3263	26.2524	31.8407	26.7353	0.5144	0.4829	2.0576	1.9316
5	26.4848	26.3810	27.0204	26.8720	0.5356	0.4910	2.1424	1.9640
6	26.3478	26.4972	26.8892	27.0175	0.5414	0.5203	2.1656	2.0812

Table 387. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4807	31.4349	31.9726	31.9270	0.4919	0.4921	1.9676	1.9684
2	31.3605	31.2394	31.8553	31.7235	0.4948	0.4841	1.9792	1.9364
3	26.2585	26.2727	26.7662	26.7895	0.5077	0.5168	2.0308	2.0672
4	31.2108	26.2773	31.7210	26.7969	0.5102	0.5196	2.0408	2.0784
5	31.5285	26.4203	32.0410	26.9358	0.5125	0.5155	2.0500	2.0620
6	31.2654	26.3755	31.7678	26.8925	0.5024	0.5170	2.0096	2.0680

Table 388. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	26.3328	26.2532	26.7336	26.7489	0.4008	0.4957	1.6032	1.9828
2	26.1762	26.3700	26.6139	26.8540	0.4377	0.4840	1.7508	1.9360
3	26.3765	26.3915	26.8081	26.8683	0.4316	0.4768	1.7264	1.9072
4	26.2586	31.3888	26.7064	31.8405	0.4478	0.4517	1.7912	1.8068
5	31.1582	31.2669	31.5794	31.7072	0.4212	0.4403	1.6848	1.7612
6	31.3990	31.4766	31.8302	31.9501	0.4312	0.4735	1.7248	1.8940

Table 389. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	26.4399	31.3930	26.8994	31.8832	0.4595	0.4902	1.8380	1.9608
2	26.4027	31.2151	26.6643	31.6240	0.2616	0.4089	1.0464	1.6356
3	26.4052	26.3641	26.6699	26.7595	0.2647	0.3954	1.0588	1.5816
4	31.5111	26.3880	31.7097	26.8208	0.1986	0.4328	0.7944	1.7312
5	26.2382	26.2523	26.4897	26.7016	0.2515	0.4493	1.0060	1.7972
6	26.2995	31.4404	26.5616	31.8852	0.2621	0.4448	1.0484	1.7792

Table 390. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	31.4308	26.3869	31.8911	26.8826	0.4603	0.4957	1.8412	1.9828
2	26.4154	26.2687	26.6502	26.6563	0.2348	0.3876	0.9392	1.5504
3	31.2064	26.4153	31.4018	26.6991	0.1954	0.2838	0.7816	1.1352
4	26.4093	26.1986	26.6194	26.4860	0.2101	0.2874	0.8404	1.1496
5	31.3689	31.3919	31.5640	31.6627	0.1951	0.2708	0.7804	1.0832
6	31.4182	26.2823	31.5953	26.5558	0.1771	0.2735	0.7084	1.0940

Table 391. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 6('-'indicates No data available).

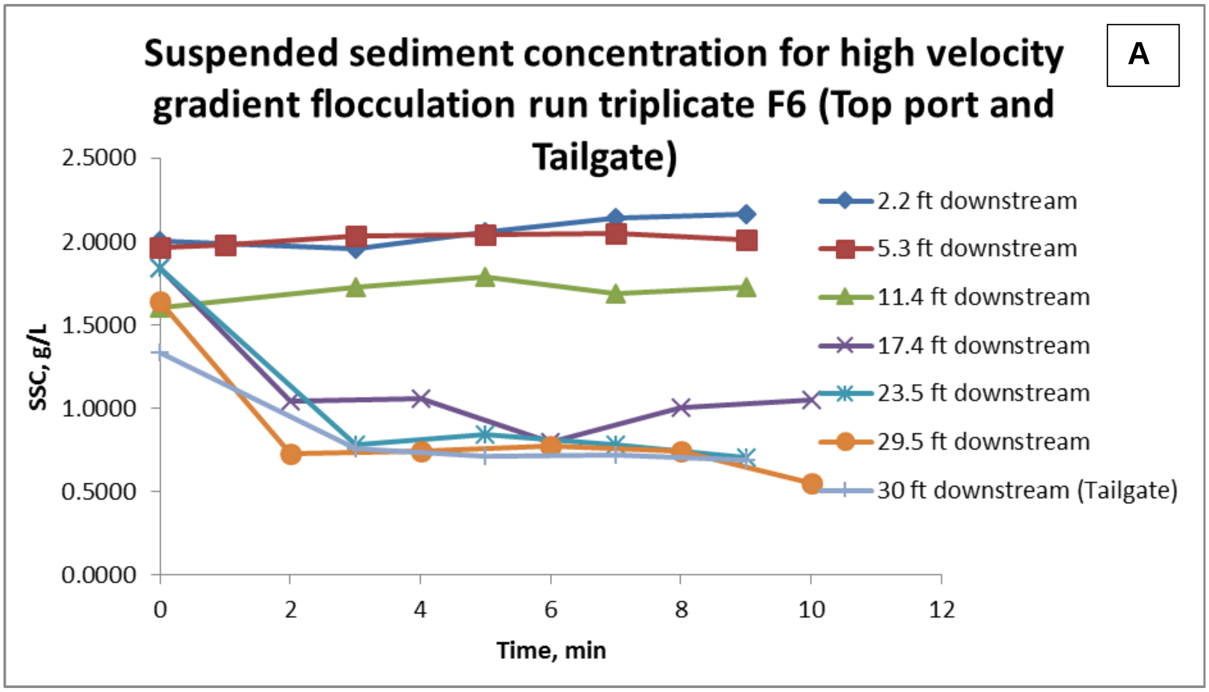
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	31.1768	26.4338	31.5880	26.8955	0.4112	0.4617	1.6448	1.8468
2	31.2222	26.4103	31.4037	26.6926	0.1815	0.2823	0.7260	1.1292
3	31.1988	26.4064	31.3853	26.6425	0.1865	0.2361	0.7460	0.9444
4	26.3734	26.3890	26.5666	26.6184	0.1932	0.2294	0.7728	0.9176
5	26.3973	31.3419	26.5834	31.5746	0.1861	0.2327	0.7444	0.9308
6	31.5286	26.3364	31.6655	26.5720	0.1369	0.2356	0.5476	0.9424

Table 392. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	31.2249	31.5583	0.3334	1.3336
2	26.2828	26.7485	0.4657	1.8628
3	31.3971	31.5875	0.1904	0.7616
4	31.5025	31.6816	0.1791	0.7164
5	31.4752	31.6551	0.1799	0.7196
6	31.5759	31.7476	0.1717	0.6868

Table 393. Mass of the sediment settled in the trays for high velocity gradient flocculation run triplicate F6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.90	405.95	12.05
2	66.85	126.05	59.20
3	66.80	150.20	83.40
4	74.15	158.35	84.20
5	141.15	394.25	253.10
6	216.50	645.35	428.85
7	146.35	629.55	483.20
8	145.00	423.05	278.05
9	144.50	362.70	218.20
10	136.40	256.70	120.30
11	141.40	231.60	90.20



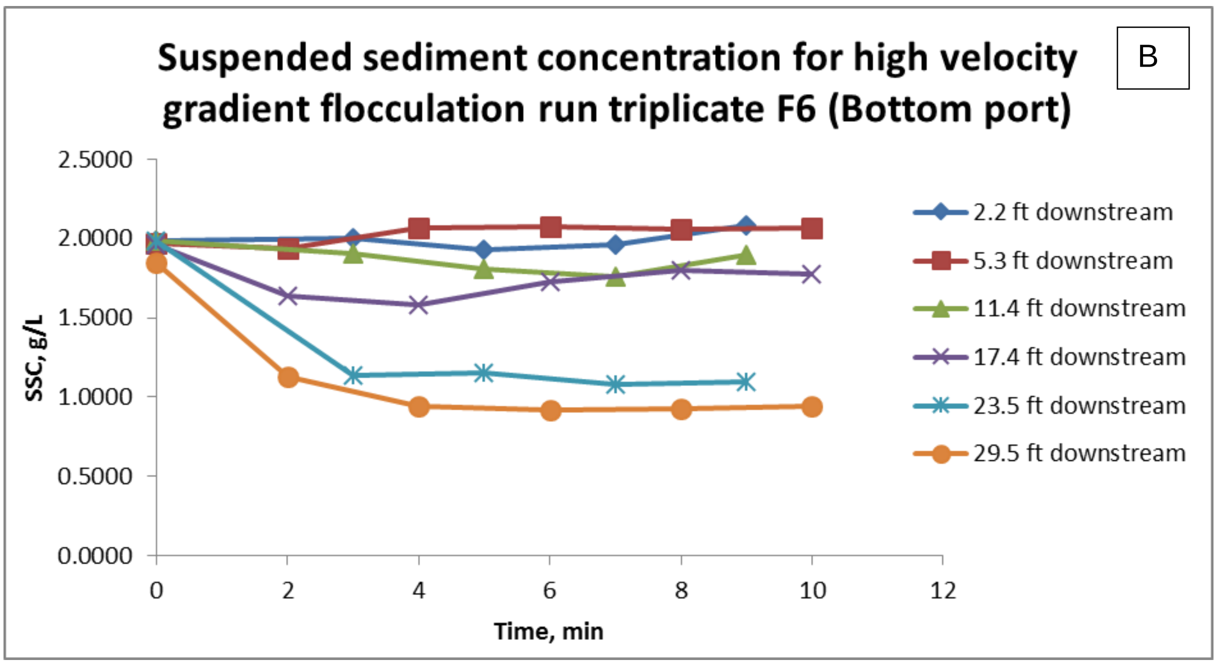


Figure 108: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

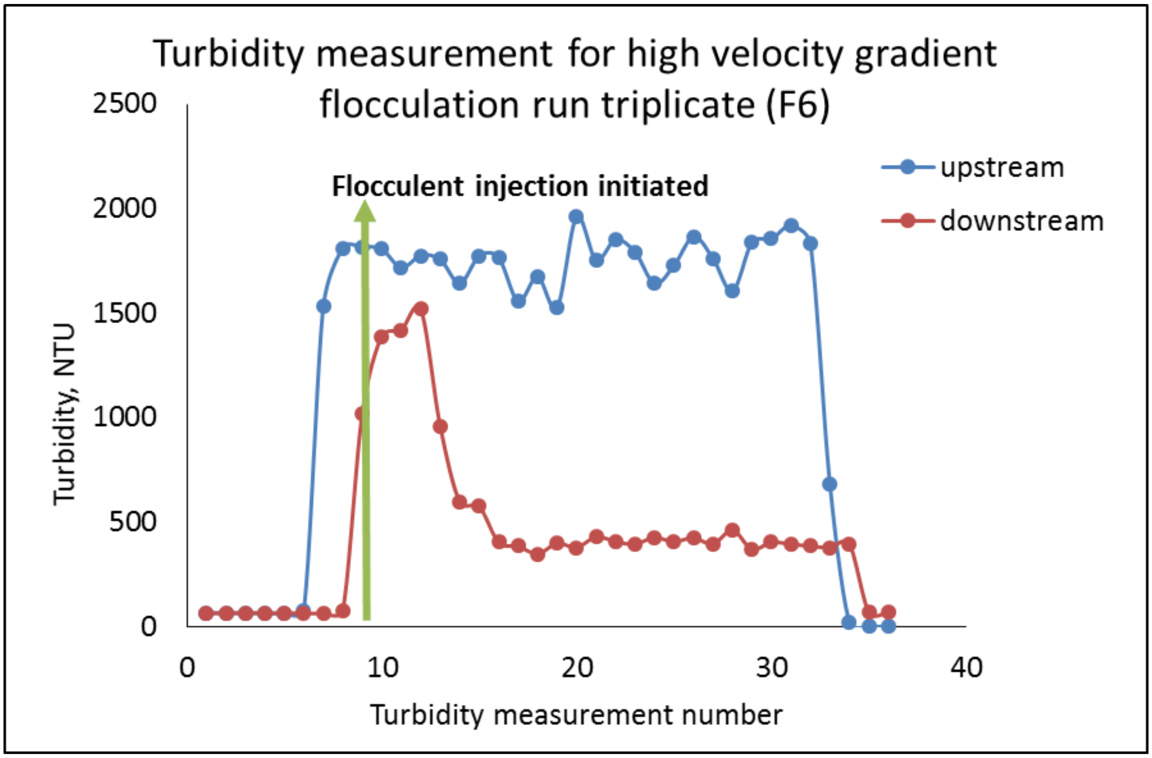


Figure 109: Graph of upstream and downstream turbidity measured for the high velocity gradient flocculation run triplicate F6.

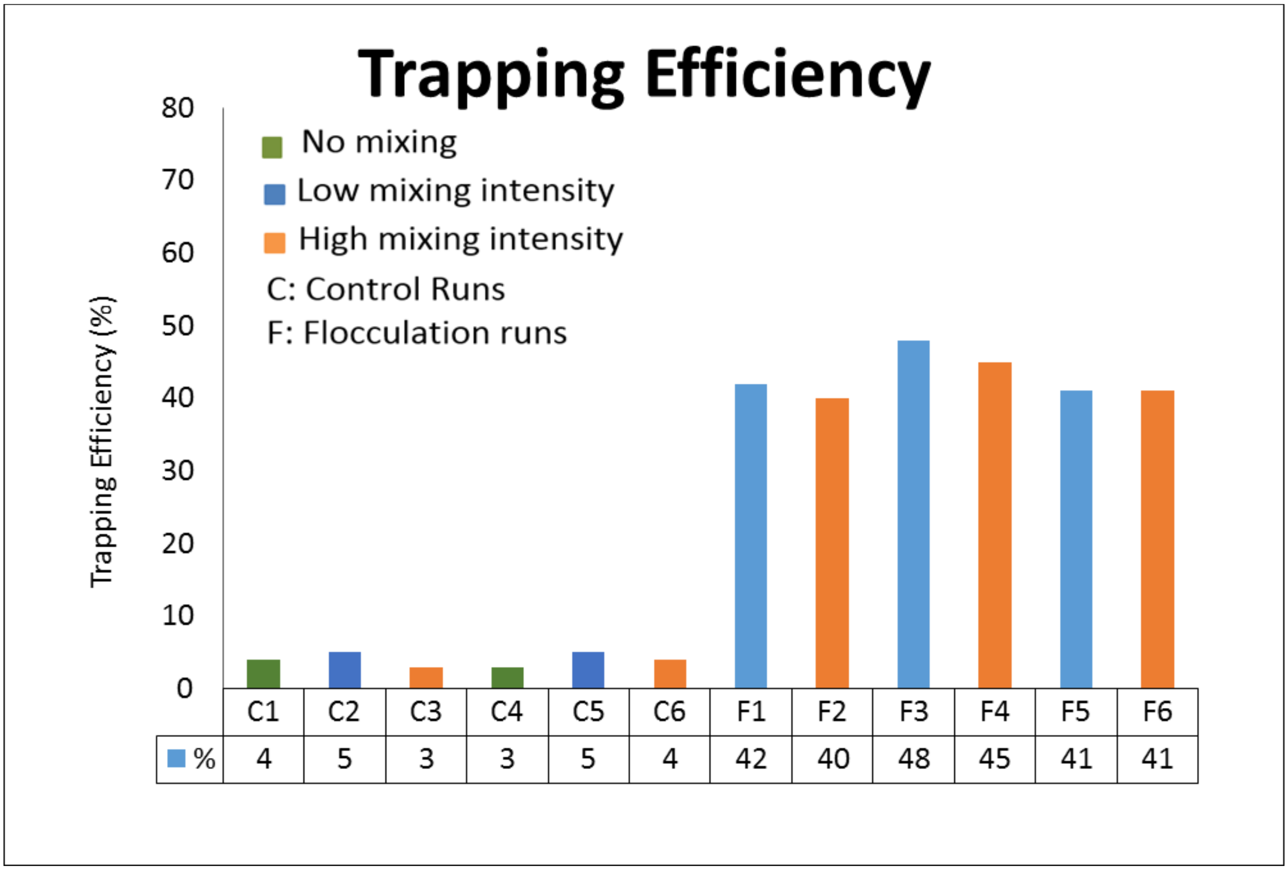


Figure 110.Trapping efficiencies for Norge B soil.

Table 394: Values of the stickiness coefficient α for the Pacolet soil (F: Flocculation run; Number: Experiment run number)

Low Velocity Gradient Run	High Velocity Gradient Run
F1: α= 1.2	F2: α=1.2
F3 (duplicate): α= 1.15	F4 (duplicate): α= 1.5
F5 (triplicate): α=1.2	F6 (triplicate): α=3.5 (error on measurement)

Data Analysis for Stephenville B Soil

In the following section, data for the suspended sediment concentration and the flocculation constants for the Stephenville B soil are presented. The summary of all the experimental runs done on Stephenville B soil is presented in Table 395.

Table 395. Summary of the experimental runs done on Port B soil ('-' indicates that no data available; NA: Not Applicable).

Run No.	Description	Oscillation speed (rpm)	Velocity gradient (sec^{-1})	Sediment flow rate (l/min)	Incoming sediment concentration (g/l)	Flow rate of water (l/min)	Flocculant concentration (g/L)
C1	Low velocity gradient control run	99	104	24.7	9.5	144	NA
C2	High velocity gradient control run	148	134	24.5	15.3	170	NA
C3	Low velocity gradient control run duplicate	99	104	27.9	16.4	170	NA
C4	Control run without agitation	0	1.57	21.1	14.6	171	NA
C5	Control run without agitation duplicate	0	1.57	18.8	18.5	171	NA
C6	High velocity gradient control run duplicate	148	134	18.8	18.5	171	NA
F1	Low velocity gradient flocculation run	99	104	24.5	16.1	171	0.015
F2	High velocity gradient flocculation run	148	134	24.5	15.0	170.0	0.015
F3	Low velocity gradient flocculation run duplicate	99	104	24.5	14.22	171	0.015
F4	High velocity gradient flocculation run duplicate	148	134	24.5	15.8	171	0.015
F5	Low velocity gradient flocculation run triplicate	99	104	20	17.7	226	0.015
F6	High velocity gradient flocculation run triplicate	148	134	35.3	16.6	171	0.015

Stephenville B low velocity gradient control run C1

Tables 396 to 403 shows the sediment concentration measured all the six stations and the tailgate. Table 305 shows the mass of the sediment that settled in the trays at the bottom of the flume. Figure 111 shows the concentration of the sediment measured at the top and bottom ports, and Figure 112 shows the graph of the upstream and downstream turbidity measured throughout the run.

Table 396. Suspended sediment concentration for low velocity gradient control run C1 at Station 1 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	31.3441	26.4332	31.7427	26.8514	0.3986	0.4182	1.5944	1.6728
2	31.4718	26.3836	31.8582	26.7794	0.3864	0.3958	1.5456	1.5832
3	26.2656	26.2676	26.6581	26.6741	0.3925	0.4065	1.5700	1.6260
4	26.2471	26.2532	26.6310	26.6486	0.3839	0.3954	1.5356	1.5816
5	26.4912	26.2478	26.8782	26.6432	0.3870	0.3954	1.5480	1.5816
6	31.3881	26.2961	31.7707	26.6933	0.3826	0.3972	1.5304	1.5888

Table 397. Suspended sediment concentration for low velocity gradient control run C1 at Station 2 ('-' indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	31.3604	26.3044	31.6978	26.7340	0.3374	0.4296	1.3496	1.7184
2	31.3220	26.2715	31.7011	26.6607	0.3791	0.3892	1.5164	1.5568
3	31.3763	26.2844	31.7481	26.6783	0.3718	0.3939	1.4872	1.5756
4	31.3544	31.4549	31.7247	31.8353	0.3703	0.3804	1.4812	1.5216
5	31.1530	26.3137	31.5227	26.6977	0.3697	0.3840	1.4788	1.5360
6	26.4317	31.5229	26.8080	31.9020	0.3763	0.3791	1.5052	1.5164

Table 398. Suspended sediment concentration for low velocity gradient control run C1 at Station 3 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2269	26.3972	26.6094	26.7708	0.3825	0.3736	1.5300	1.4944
2	26.3708	26.2546	26.7512	26.6503	0.3804	0.3957	1.5216	1.5828
3	31.4099	26.2611	31.7743	26.6617	0.3644	0.4006	1.4576	1.6024
4	31.4311	26.2731	31.7967	26.6778	0.3656	0.4047	1.4624	1.6188
5	26.2713	26.2891	26.6518	26.6802	0.3805	0.3911	1.5220	1.5644
6	26.4315	31.5198	26.8168	31.8904	0.3853	0.3706	1.5412	1.4824

Table 399. Suspended sediment concentration for low velocity gradient control run C1 at Station 4 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3688	26.4771	31.7404	26.8682	0.3716	0.3911	1.4864	1.5644
2	31.4440	26.4148	31.8170	26.8125	0.3730	0.3977	1.4920	1.5908
3	26.4762	26.2760	26.8520	26.6689	0.3758	0.3929	1.5032	1.5716
4	31.5292	26.3002	31.9084	26.6938	0.3792	0.3936	1.5168	1.5744
5	31.3730	31.3724	31.9508	31.7522	0.5778	0.3798	2.3112	1.5192
6	26.4111	26.4964	26.7868	26.8835	0.3757	0.3871	1.5028	1.5484

Table 400. Suspended sediment concentration for low velocity gradient control run C1 at Station 5 ('-' indicates No data available)

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2567	31.1453	26.6291	31.5144	0.3724	0.3691	1.4896	1.4764
2	31.3711	26.3661	31.7342	26.7634	0.3631	0.3973	1.4524	1.5892
3	31.3654	31.4773	31.7314	31.8556	0.3660	0.3783	1.4640	1.5132
4	26.2715	31.4256	26.6523	31.8023	0.3808	0.3767	1.5232	1.5068
5	31.4895	31.1433	31.8470	31.5237	0.3575	0.3804	1.4300	1.5216
6	31.3280	26.4143	31.6999	26.7979	0.3719	0.3836	1.4876	1.5344

Table 401. Suspended sediment concentration for low velocity gradient control run C1 at Station 6 ('-' indicates No data available)

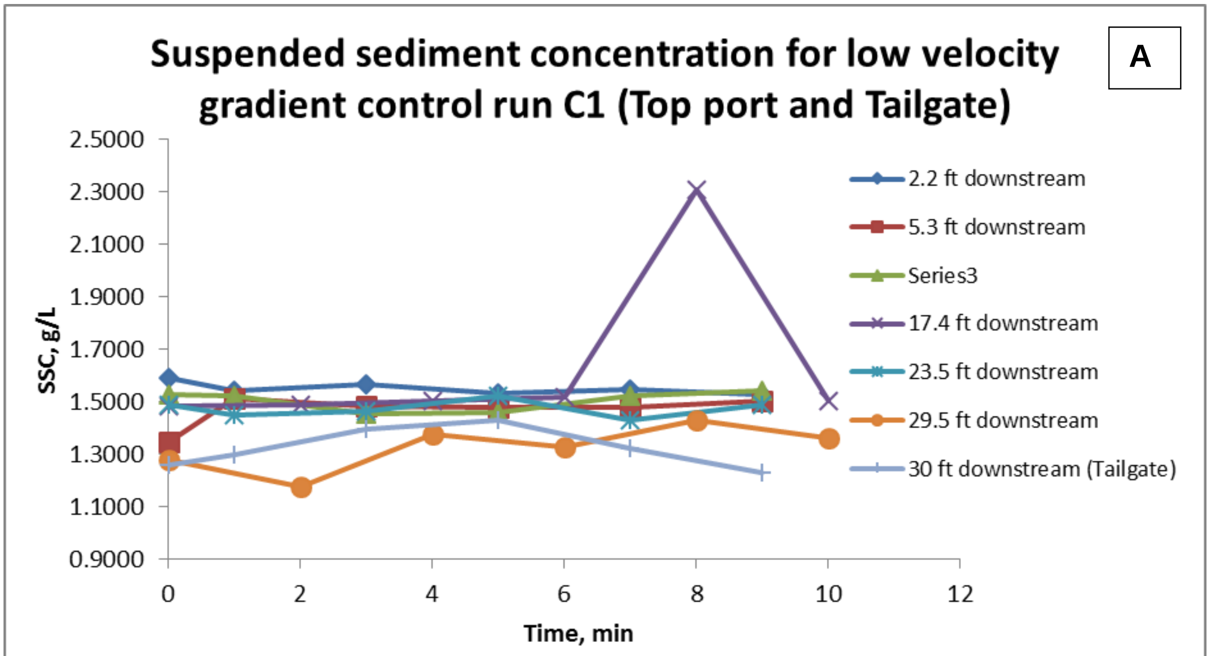
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2226	31.4829	31.5421	31.8087	0.3195	0.3258	1.2780	1.3032
2	31.2825	31.3824	31.5770	31.7469	0.2945	0.3645	1.1780	1.4580
3	31.2021	31.3761	31.5462	31.7495	0.3441	0.3734	1.3764	1.4936
4	31.3720	26.2430	31.7046	26.6184	0.3326	0.3754	1.3304	1.5016
5	26.3100	31.4797	26.6680	31.8387	0.3580	0.3590	1.4320	1.4360
6	31.2178	26.3491	31.5586	26.7137	0.3408	0.3646	1.3632	1.4584

Table 402. Suspended sediment concentration for low velocity gradient control run C1 at tailgate ('-' indicates No data available)

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment concentration g/L
1	26.4710	26.7863	0.3153	1.2612
2	31.4821	31.8067	0.3246	1.2984
3	31.3800	31.7291	0.3491	1.3964
4	26.3711	26.7288	0.3577	1.4308
5	26.4836	26.8145	0.3309	1.3236
6	31.4173	31.7256	0.3083	1.2332

Table 403: Mass of the sediment settled on the trays for low velocity gradient control run C1

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.80	399.35	6.55
2	830.75	849.10	18.35
3	829.05	846.35	17.30
4	433.50	451.75	18.25
5	789.00	807.70	18.70
6	868.30	886.30	18.00
7	433.65	452.75	19.10
8	788.40	806.00	17.60
9	789.10	803.45	14.35
10	828.20	839.15	10.95
11	830.25	845.85	15.60



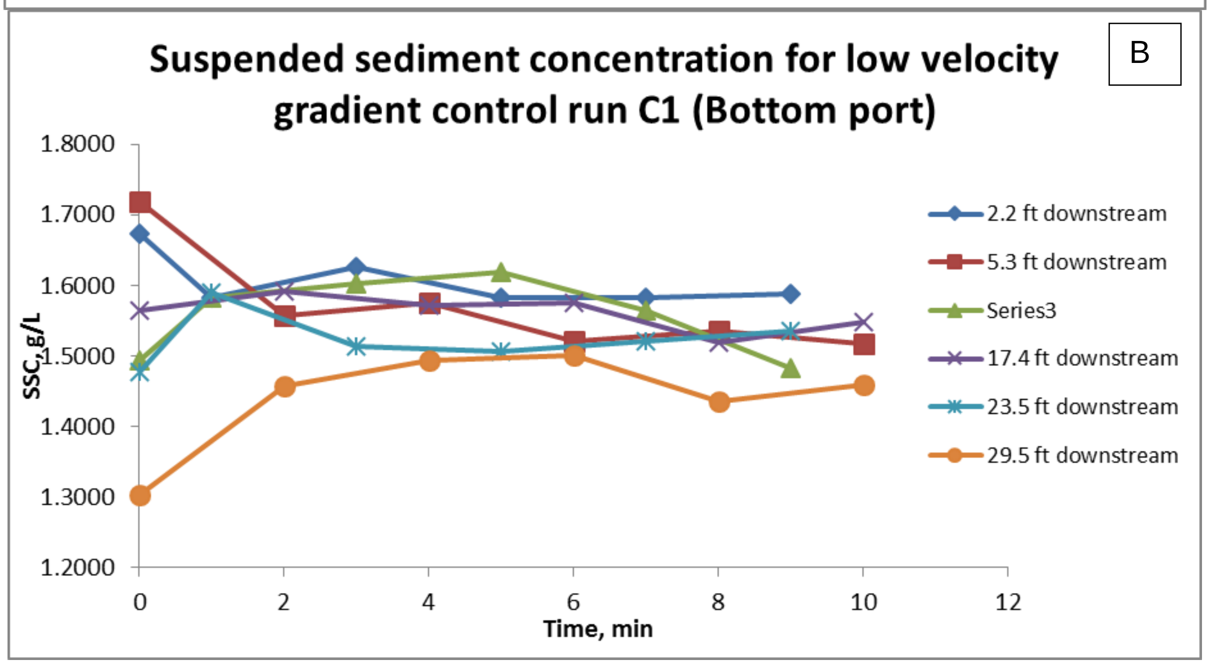


Figure 111. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

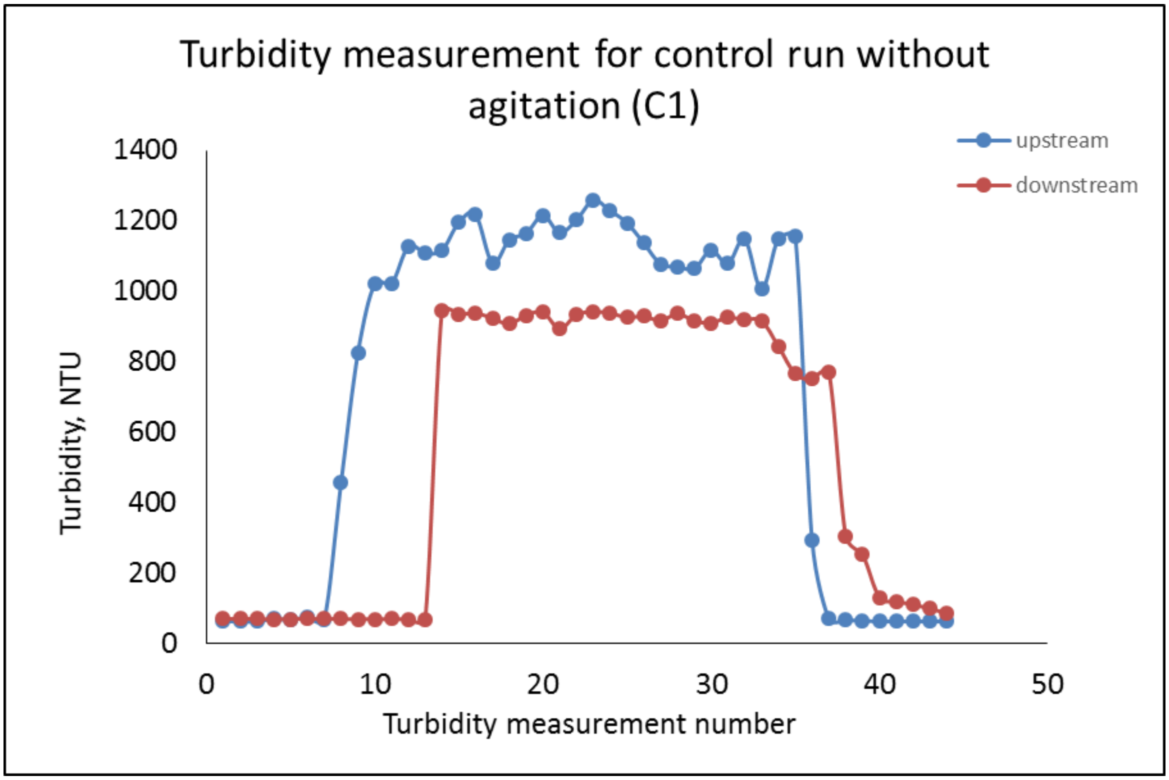


Figure 112. Upstream and downstream turbidity for low velocity gradient control run C1. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument

Stephenville B High Velocity Gradient Control Run (C2)

Since the nature of the control run with agitation was the same for both soils, the speed of the oscillating grids for this run was set at 148 rpm. Tables 404 to 411 show the data related to the sediment concentration measured at the sampling ports, and mass of the flocculated matter that settled in the trays respectively.

Table 404. Suspended sediment concentration for high velocity gradient control run (C2).at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4350	26.3994	32.0037	27.0006	0.5687	0.6012	2.2748	2.4048
2	31.3933	31.4944	31.9550	32.0818	0.5617	0.5874	2.2468	2.3496
3	26.3152	26.2985	26.8781	26.8924	0.5629	0.5939	2.2516	2.3756
4	31.3727	26.3133	31.9353	26.8920	0.5626	0.5787	2.2504	2.3148
5	26.3836	31.4016	26.9445	31.9734	0.5609	0.5718	2.2436	2.2872
6	31.4820	26.4237	32.0290	27.0292	0.5470	0.6055	2.1880	2.4220

Table 405. Suspended sediment concentration for high velocity gradient control run (C2).at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4024	26.3442	31.9525	26.9388	0.5501	0.5946	2.2004	2.3784
2	26.2620	31.3632	26.8304	31.9302	0.5684	0.5670	2.2736	2.2680
3	26.3099	26.4245	26.8876	26.9977	0.5777	0.5732	2.3108	2.2928
4	26.2661	26.2610	26.8259	26.8322	0.5598	0.5712	2.2392	2.2848
5	26.3864	26.2489	26.9488	26.8287	0.5624	0.5798	2.2496	2.3192
6	31.3856	31.4368	31.9509	31.9985	0.5653	0.5617	2.2612	2.2468

Table 406. Suspended sediment concentration for high velocity gradient control run (C2).at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2546	31.4004	26.7968	31.9574	0.5422	0.5570	2.1688	2.2280
2	26.4221	26.2774	26.9767	26.8517	0.5546	0.5743	2.2184	2.2972
3	26.2980	26.4042	26.8443	26.9624	0.5463	0.5582	2.1852	2.2328
4	26.3860	26.4921	26.9366	27.0415	0.5506	0.5494	2.2024	2.1976
5	26.2401	26.4166	26.8008	26.9734	0.5607	0.5568	2.2428	2.2272
6	31.4388	26.3909	31.9602	26.9493	0.5214	0.5584	2.0856	2.2336

Table 407. Suspended sediment concentration for high velocity gradient control run (C2).at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4996	31.2294	27.0537	31.8071	0.5541	0.5777	2.2164	2.3108
2	31.3529	26.3063	31.8859	26.8849	0.5330	0.5786	2.1320	2.3144
3	26.3925	31.3963	26.9531	31.9693	0.5606	0.5730	2.2424	2.2920
4	26.2746	26.3029	26.8212	26.8820	0.5466	0.5791	2.1864	2.3164
5	26.3594	26.3510	26.9087	26.9162	0.5493	0.5652	2.1972	2.2608
6	31.3869	31.3951	31.9370	31.9596	0.5501	0.5645	2.2004	2.2580

Table 408. Suspended sediment concentration for high velocity gradient control run (C2).at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.1614	31.4307	31.6787	31.9690	0.5173	0.5383	2.0692	2.1532
2	31.1562	26.2983	31.6915	26.8678	0.5353	0.5695	2.1412	2.2780
3	26.1507	31.3694	26.6920	31.9222	0.5413	0.5528	2.1652	2.2112
4	31.3754	26.2903	31.9042	26.8665	0.5288	0.5762	2.1152	2.3048
5	31.4032	31.3550	31.9297	31.9110	0.5265	0.5560	2.1060	2.2240
6	26.2733	26.4590	26.8249	27.0198	0.5516	0.5608	2.2064	2.2432

Table 409. Suspended sediment concentration for high velocity gradient control run (C2).at Station 6

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2585	26.3018	26.7272	26.8358	0.4687	0.5340	1.8748	2.1360
2	26.2923	26.2656	26.8150	26.8240	0.5227	0.5584	2.0908	2.2336
3	26.3798	31.4691	26.9032	32.0154	0.5234	0.5463	2.0936	2.1852
4	26.3430	26.4149	26.8752	26.9742	0.5322	0.5593	2.1288	2.2372
5	26.4134	26.3360	26.9402	26.8987	0.5268	0.5627	2.1072	2.2508
6	26.3095	26.4330	26.8244	26.9921	0.5149	0.5591	2.0596	2.2364

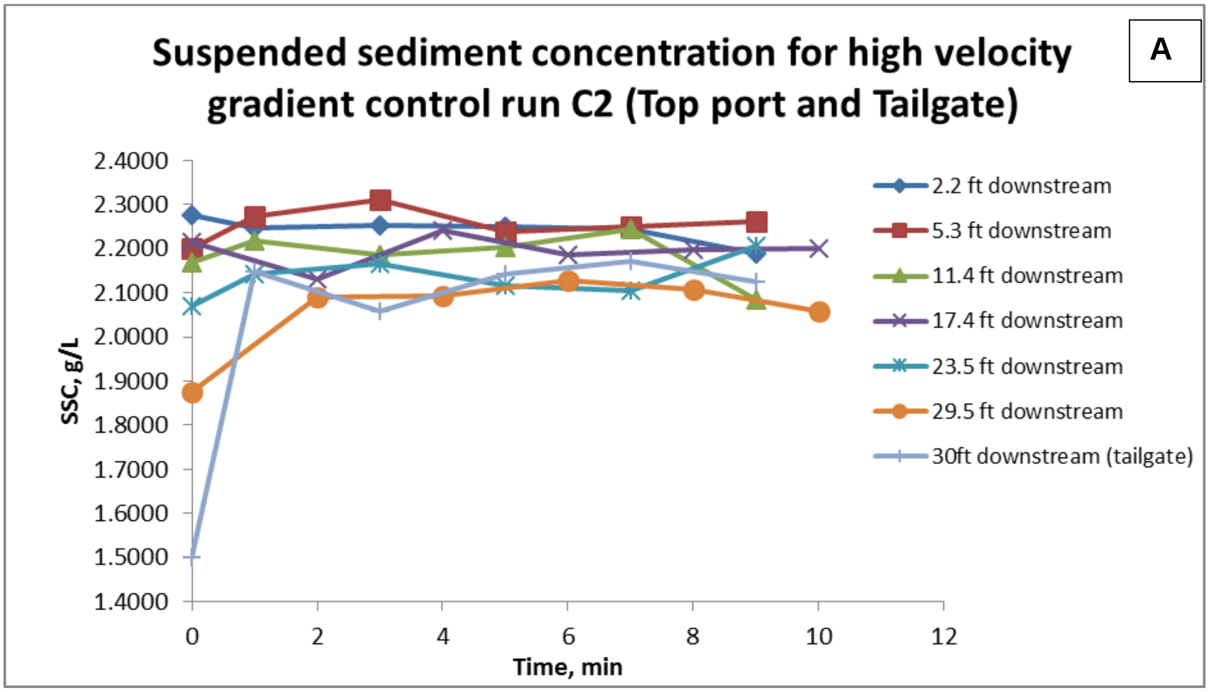
Table 410. Suspended sediment concentration for high velocity gradient control run (C2).at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.4444	26.8199	0.3755	1.5020
2	26.2795	26.8164	0.5369	2.1476
3	31.3917	31.9062	0.5145	2.0580
4	26.3727	26.9083	0.5356	2.1424
5	26.2655	26.8081	0.5426	2.1704
6	31.3320	31.8631	0.5311	2.1244

Table 411. Mass of the sediment settled in the trays for high velocity gradient control run (C2).

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.8	398.35	5.55
2	786.35	804.3	17.95
3	825.05	845.8	20.75
4	828.95	852.55	23.60
5	829.05	851.8	22.75
6	826.3	852.75	26.45
7	436.5	456.95	20.45
8	784.9	808.2	23.30
9	868.1	892.4	24.30
10	868.35	890.5	22.15
11	830.65	855.7	25.05

Figure 113 below shows the graph of the sediment concentration for this run, and Figure 114 shows the graph of the upstream and downstream turbidity.



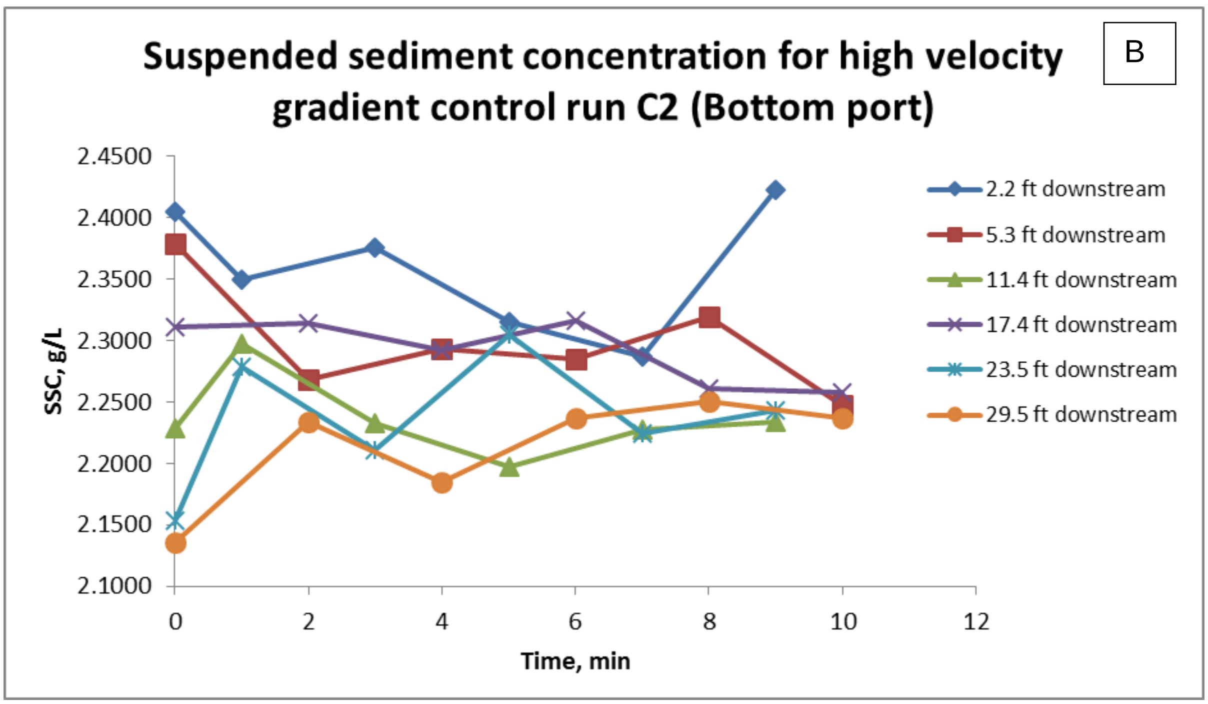


Figure 113. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1-minute interval from odd numbered and even numbered stations alternately

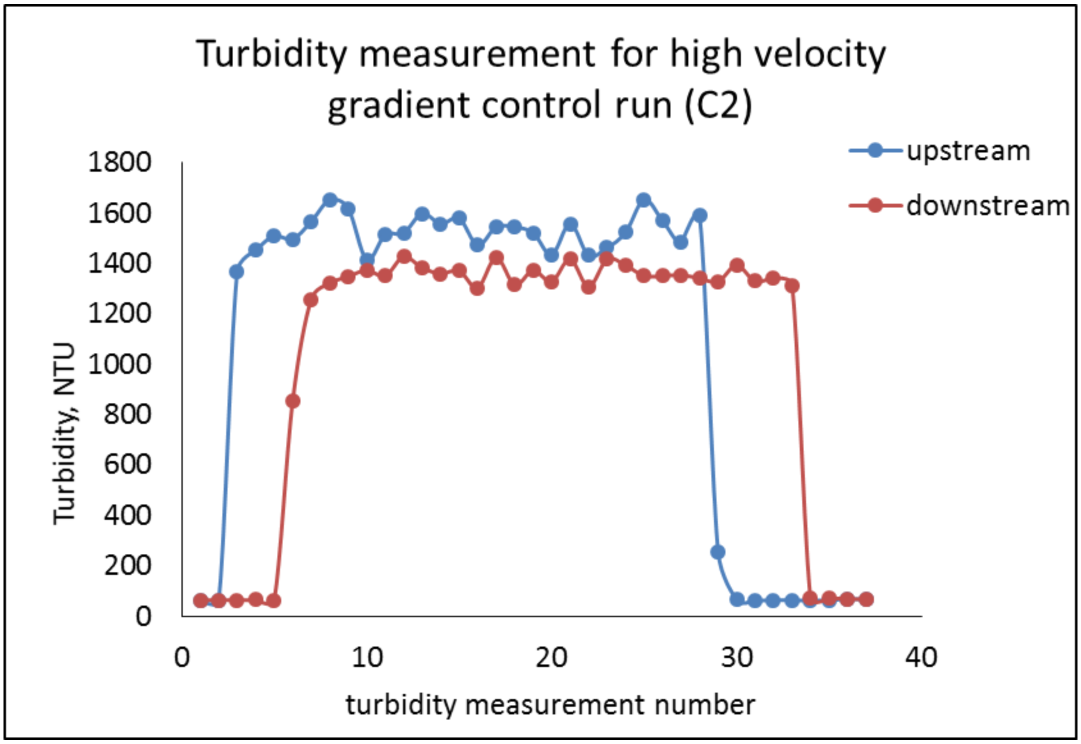


Figure 114. Upstream and downstream turbidity for high velocity gradient control run C2. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Stephenville B low velocity gradient control run duplicate (C3)</u>

Tables 412 to 418 shows the data for the concentration of the suspended sediments, and Table 419 shows the data of the mass of the sediments that settled in the trays at the end of the run. Figure 115 and 116 shows the graph of the suspended sediment concentration and the measured upstream and downstream turbidity

Table 412. Suspended sediment concentration for low velocity gradient control run duplicate C3 at Station 1('-'indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4104	26.2975	31.9781	26.9345	0.5677	0.6370	2.2708	2.5480
2	31.4478	31.4461	32.0496	32.0482	0.6018	0.6021	2.4072	2.4084
3	31.4323	26.2859	32.0188	26.9162	0.5865	0.6303	2.3460	2.5212
4	26.3319	26.5004	26.9233	27.1074	0.5914	0.6070	2.3656	2.4280
5	26.2847	26.3376	26.8827	26.9557	0.5980	0.6181	2.3920	2.4724
6	26.2606	26.3028	26.8593	26.9047	0.5987	0.6019	2.3948	2.4076

Table 413. Suspended sediment concentration for low velocity gradient control run duplicate C3 at Station 2('-'indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4500	26.2519	32.0461	26.8586	0.5961	0.6067	2.3844	2.4268
2	26.2602	26.2469	26.8686	26.8539	0.6084	0.6070	2.4336	2.4280
3	26.3882	26.3018	26.9904	26.9078	0.6022	0.6060	2.4088	2.4240
4	26.3853	26.2516	26.9772	26.8595	0.5919	0.6079	2.3676	2.4316
5	26.2690	26.3393	26.8627	26.9458	0.5937	0.6065	2.3748	2.4260
6	26.3738	26.2855	26.9616	26.8869	0.5878	0.6014	2.3512	2.4056

Table 414. Suspended sediment concentration for low velocity gradient control run duplicate C3 at Station 3('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4736	26.3113	27.0594	26.9512	0.5858	0.6399	2.3432	2.5596
2	26.3166	26.4378	26.9154	27.0587	0.5988	0.6209	2.3952	2.4836
3	26.3148	26.3835	26.9606	26.9852	0.6458	0.6017	2.5832	2.4068
4	26.4762	26.3820	27.0824	27.0165	0.6062	0.6345	2.4248	2.5380
5	26.2362	26.3078	26.8469	26.9363	0.6107	0.6285	2.4428	2.5140
6	26.4541	26.3879	27.0661	26.9967	0.6120	0.6088	2.4480	2.4352

Table 415. Suspended sediment concentration for low velocity gradient control run duplicate C3 at Station 4('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4475	26.2788	26.9451	26.8480	0.4976	0.5692	1.9904	2.2768
2	26.2590	26.3011	26.8479	26.9129	0.5889	0.6118	2.3556	2.4472
3	26.4126	26.3011	26.9954	26.8977	0.5828	0.5966	2.3312	2.3864
4	26.3833	26.3763	26.9667	26.9751	0.5834	0.5988	2.3336	2.3952
5	26.2800	26.2650	26.8314	26.8580	0.5514	0.5930	2.2056	2.3720
6	26.3839	26.4055	26.9586	27.0011	0.5747	0.5956	2.2988	2.3824

Table 416. Suspended sediment concentration for low velocity gradient control run duplicate C3 at Station 5('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2461	26.3905	26.8262	26.9691	0.5801	0.5786	2.3204	2.3144
2	26.2448	26.4200	26.8369	26.9948	0.5921	0.5748	2.3684	2.2992
3	26.3436	26.3838	26.9346	26.9901	0.5910	0.6063	2.3640	2.4252
4	26.3261	26.2886	26.9081	26.8898	0.5820	0.6012	2.3280	2.4048
5	26.4128	26.3934	26.9942	27.0013	0.5814	0.6079	2.3256	2.4316
6	26.2813	26.3800	26.8662	26.9761	0.5849	0.5961	2.3396	2.3844

Table 417. Suspended sediment concentration for low velocity gradient control run duplicate C3 at Station 6('-' indicates no data).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4063	26.1821	26.8969	26.7565	0.4906	0.5744	1.9624	2.2976
2	26.2377	31.1320	26.8109	31.7265	0.5732	0.5945	2.2928	2.3780
3	26.2886	26.2184	26.8622	26.8172	0.5736	0.5988	2.2944	2.3952
4	31.4922	26.3498	32.0510	26.9578	0.5588	0.6080	2.2352	2.4320
5	26.3955	26.4410	26.9601	27.0367	0.5646	0.5957	2.2584	2.3828
6	31.4044	26.2943	31.9300	26.8872	0.5256	0.5929	2.1024	2.3716

Table 418. Suspended sediment concentration for low velocity gradient control run duplicate C3 at tailgate('-' indicates no data).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.2411	26.4915	0.2504	1.0016
2	31.5399	32.0532	0.5133	2.0532
3	31.1783	31.7214	0.5431	2.1724
4	26.2717	26.8417	0.5700	2.2800
5	26.4278	26.9788	0.5510	2.2040
6	26.4285	26.9841	0.5556	2.2224

Table 419. Mass of settled sediments in the trays for low velocity gradient control run duplicate C3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.70	400.55	7.85
2	786.45	806.70	20.25
3	789.15	812.05	22.90
4	433.70	455.90	22.20
5	792.05	815.25	23.20
6	830.05	852.65	22.60
7	393.40	413.75	20.35
8	824.25	854.25	30.00
9	829.75	853.75	24.00
10	868.40	890.40	22.00
11	829.85	853.25	23.40

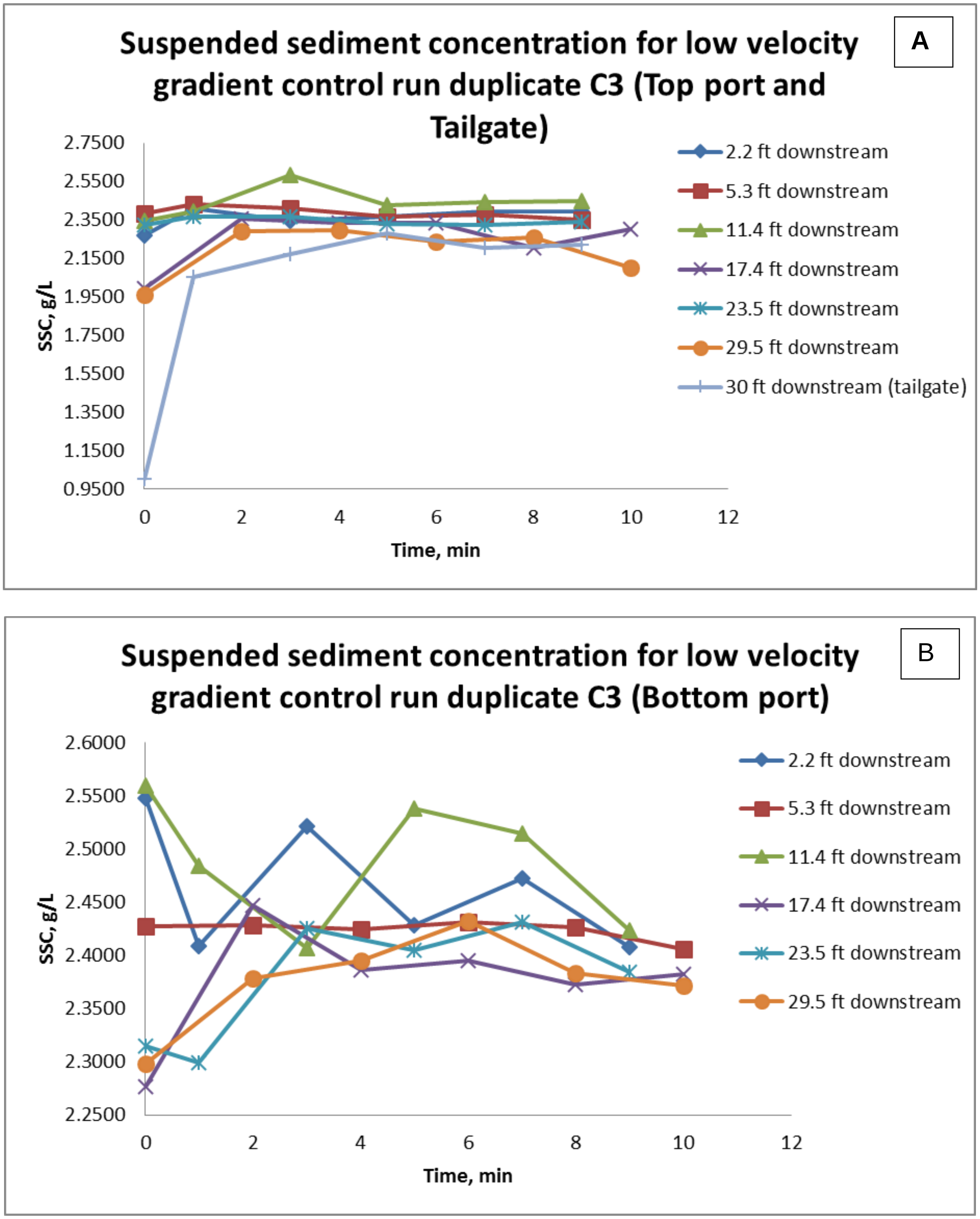


Figure 115. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

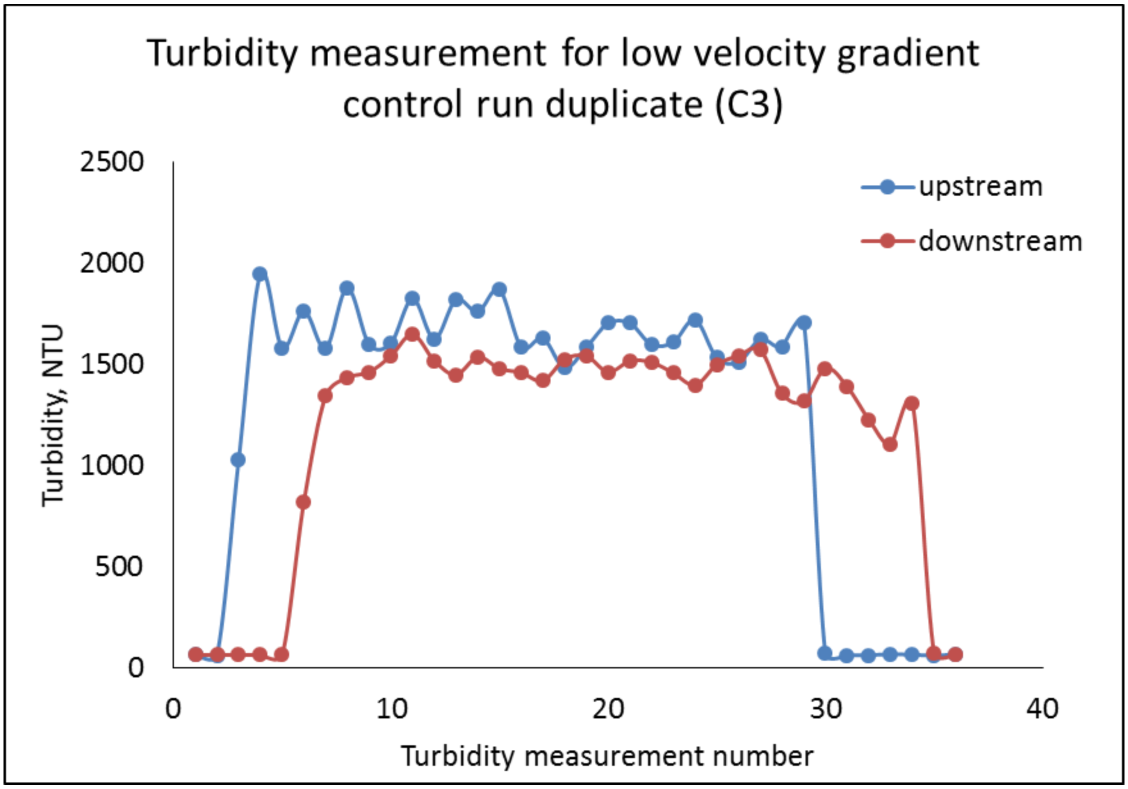


Figure 116. Upstream and downstream turbidity for low velocity gradient control run duplicate C3. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

Stephenville B Control Run without agitation (C4)

Tables 420 to 427 show the data related to the control run C4, and Figure 117 shows the graph of the suspended sediment concentration. Figure 118 shows the graph of the upstream and downstream turbidity measured for this run.

Table 420. Suspended sediment concentration for control run without agitation C4.at Station 1

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.8620	26.8411	31.9074	26.8475	0.0454	0.0064	0.1816	0.0256
2	26.7536	27.2008	26.9494	27.3598	0.1958	0.1590	0.7832	0.6360
3	26.8628	31.6000	26.9106	31.9321	0.0478	0.3321	0.1912	1.3284
4	31.4743	26.6753	31.8876	26.8382	0.4133	0.1629	1.6532	0.6516
5	26.5856	31.6700	26.7884	31.8945	0.2028	0.2245	0.8112	0.8980
6	31.6448	31.5471	31.9241	31.9109	0.2793	0.3638	1.1172	1.4552

Table 421. Suspended sediment concentration for control run without agitation C4.at Station 2

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.7480	26.6069	26.9652	26.8270	0.2172	0.2201	0.8688	0.8804
2	31.6790	26.6013	31.9154	26.8622	0.2364	0.2609	0.9456	1.0436
3	31.5114	26.6820	31.8577	26.8745	0.3463	0.1925	1.3852	0.7700
4	26.5474	26.5150	26.8180	26.8657	0.2706	0.3507	1.0824	1.4028
5	26.5860	26.4760	26.9732	26.8466	0.3872	0.3706	1.5488	1.4824
6	26.5115	26.4189	26.7861	26.7129	0.2746	0.2940	1.0984	1.1760

Table 422. Suspended sediment concentration for control run without agitation C4.at Station 3

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3970	31.6470	31.7337	31.9374	0.3367	0.2904	1.3468	1.1616
2	31.5482	31.5435	31.9013	31.9688	0.3531	0.4253	1.4124	1.7012
3	26.5166	26.3764	26.8247	26.8226	0.3081	0.4462	1.2324	1.7848
4	26.6215	31.5778	26.8136	31.9550	0.1921	0.3772	0.7684	1.5088
5	31.3136	26.4941	31.6566	26.8114	0.3430	0.3173	1.3720	1.2692
6	31.3452	26.5615	31.7079	26.8132	0.3627	0.2517	1.4508	1.0068

Table 423. Suspended sediment concentration for control run without agitation C4.at Station 4

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2760	31.5290	31.6924	31.7752	0.4164	0.2462	1.6656	0.9848
2	31.6023	31.6971	31.9993	32.0081	0.3970	0.3110	1.5880	1.2440
3	26.6051	31.5197	26.9535	31.9261	0.3484	0.4064	1.3936	1.6256
4	31.5407	31.2933	31.8826	31.7492	0.3419	0.4559	1.3676	1.8236
5	26.5236	31.6643	26.8061	32.0368	0.2825	0.3725	1.1300	1.4900
6	31.7085	26.4894	31.9961	26.8086	0.2876	0.3192	1.1504	1.2768

Table 424. Suspended sediment concentration for control run without agitation C4.at Station 5

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	T	B	T	B	T	B	T	B
1	26.5134	31.6451	26.9131	31.9198	0.3997	0.2747	1.5988	1.0988
2	26.5878	31.5930	26.8858	31.9569	0.2980	0.3639	1.1920	1.4556
3	31.5524	26.6541	31.9053	26.9824	0.3529	0.3283	1.4116	1.3132
4	26.4816	26.7787	26.6391	27.0543	0.1575	0.2756	0.6300	1.1024
5	31.3673	31.5533	31.6692	31.9150	0.3019	0.3617	1.2076	1.4468
6	26.7059	26.6468	26.9178	26.9667	0.2119	0.3199	0.8476	1.2796

Table 425. Suspended sediment concentration for control run without agitation C4.at Station 6

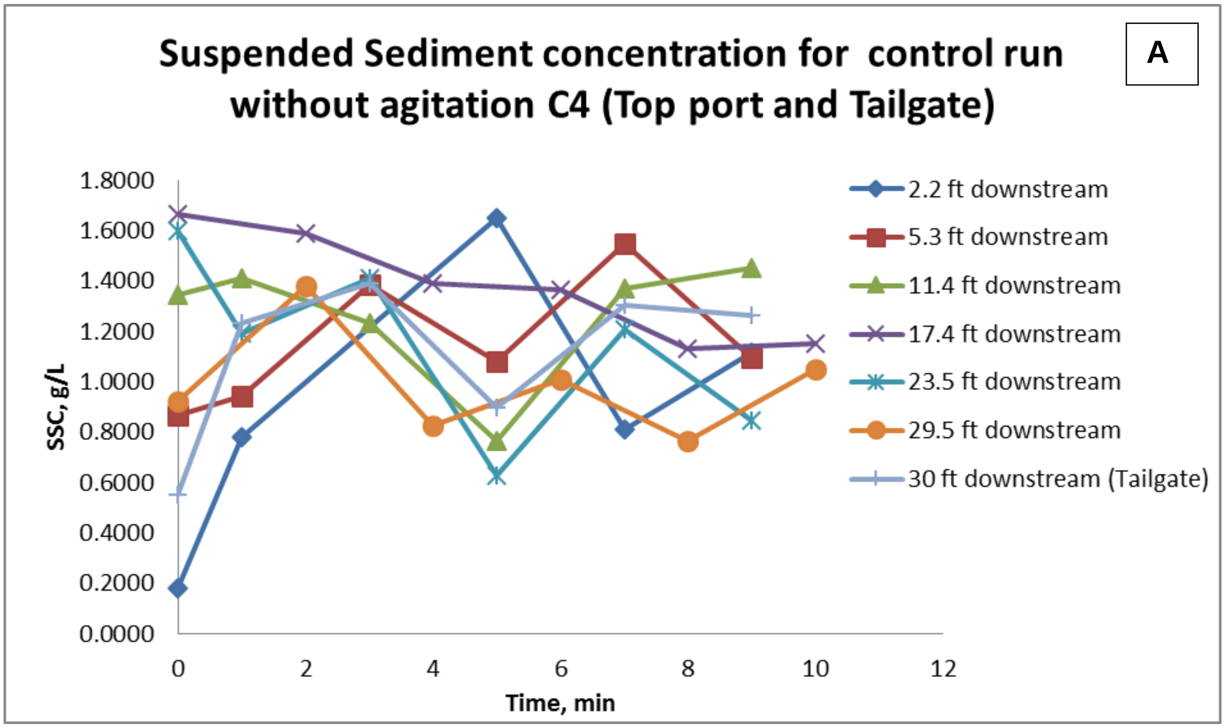
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	T	B	T	B	T	B	T	B
1	26.4370	31.5541	26.6675	31.8361	0.2305	0.2820	0.9220	1.1280
2	26.6000	26.4755	26.9458	26.8163	0.3458	0.3408	1.3832	1.3632
3	31.7540	26.5520	31.9611	26.8704	0.2071	0.3184	0.8284	1.2736
4	26.5695	26.6916	26.8220	26.9632	0.2525	0.2716	1.0100	1.0864
5	26.5550	26.7764	26.7468	26.9654	0.1918	0.1890	0.7672	0.7560
6	31.7370	26.5490	31.9994	26.8857	0.2624	0.3367	1.0496	1.3468

Table 426. Suspended sediment concentration for control run without agitation C4.at tailgate

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	31.5542	31.6929	0.1387	0.5548
2	26.5566	26.8648	0.3082	1.2328
3	31.7100	32.0579	0.3479	1.3916
4	31.7605	31.9855	0.2250	0.9000
5	26.4741	26.8000	0.3259	1.3036
6	31.3488	31.6654	0.3166	1.2664

Table 427. Mass of settled sediments in the trays for control run without agitation C4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.95	399.55	6.60
2	826.60	844.45	17.85
3	828.20	848.20	20.00
4	434.70	454.95	20.25
5	868.50	889.35	20.85
6	828.90	853.10	24.20
7	393.05	411.80	18.75
8	828.00	852.95	24.95
9	826.50	848.05	21.55
10	827.40	846.10	18.70
11	787.55	805.45	17.90



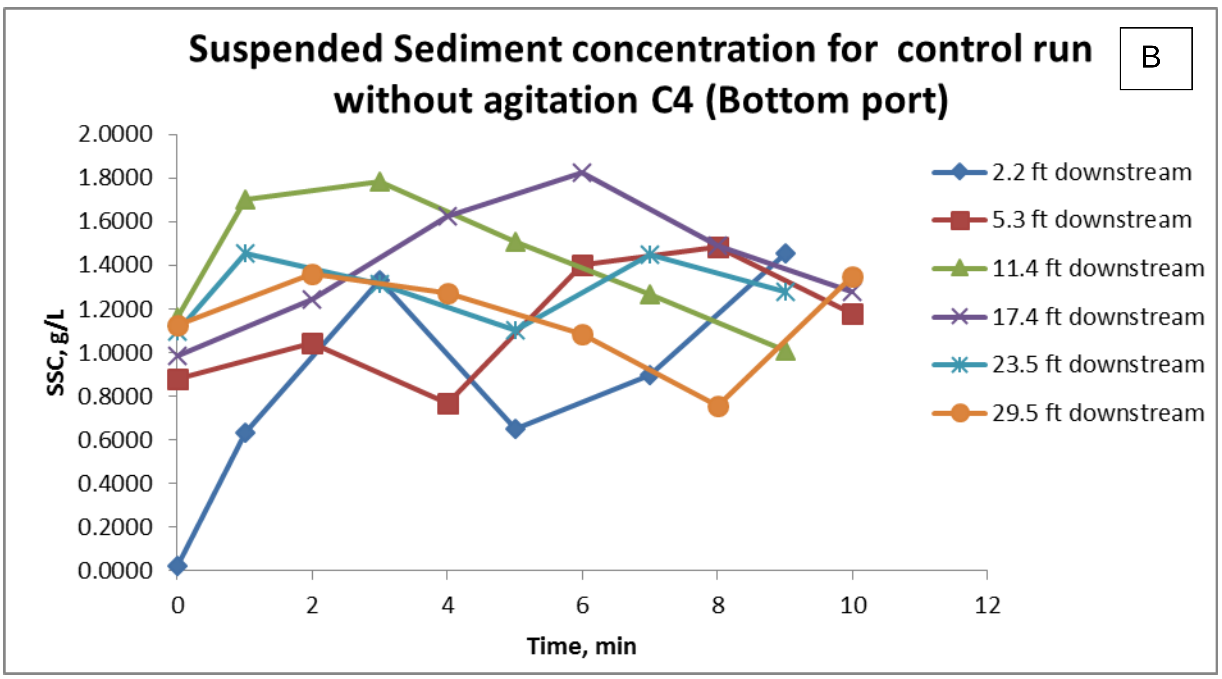


Figure 117. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

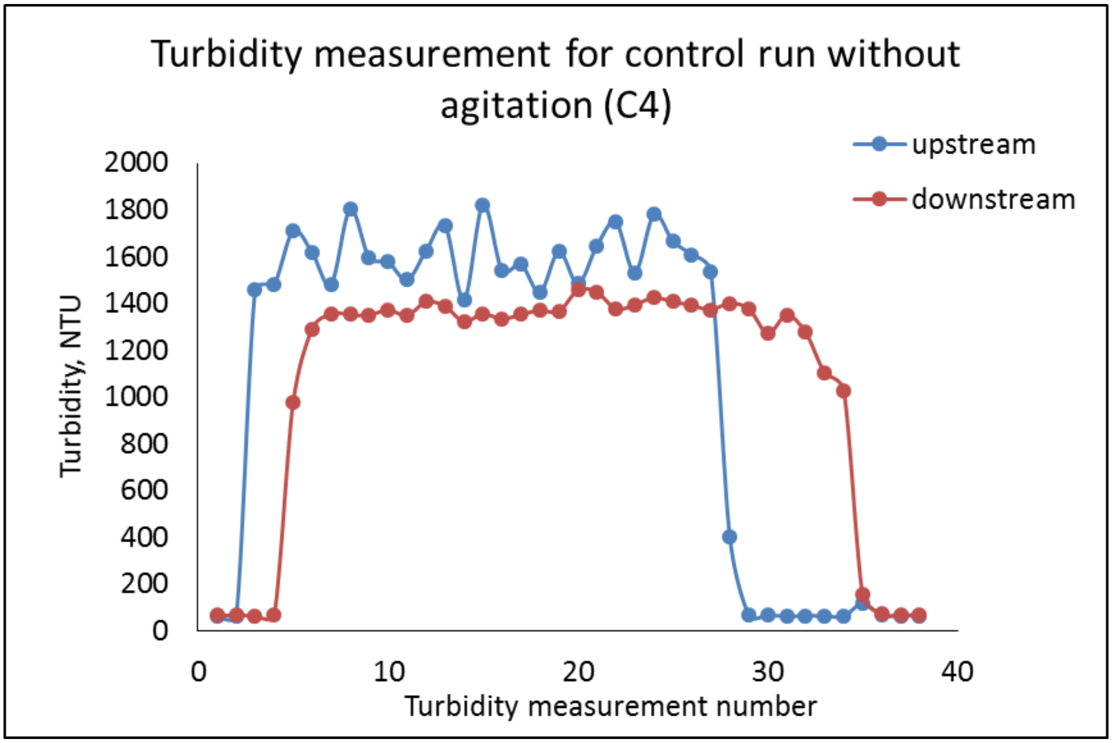


Figure 118. Upstream and downstream turbidity for control run without agitation C4. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

<u>Stephenville B control run without agitation duplicate C5</u>

Tables 428 to 435 show the measured data for this run, and Figure 119 shows the graph of the sediment concentration and Figure 120 shows the graph of the upstream and the downstream turbidity

Table 428. Suspended sediment concentration for control run without agitation duplicate C5 at Station 1('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3670	26.2888	31.9396	26.9112	0.5726	0.6224	2.2904	2.4896
2	26.3990	26.3054	26.9830	27.0152	0.5840	0.7098	2.3360	2.8392
3	26.3726	31.4384	26.9626	31.9788	0.5900	0.5404	2.3600	2.1616
4	31.3812	26.3142	31.9222	26.8908	0.5410	0.5766	2.1640	2.3064
5	26.2756	31.4081	26.8341	31.9435	0.5585	0.5354	2.2340	2.1414
6	31.5559	31.4069	31.9599	31.9455	0.4040	0.5386	1.6160	2.1544

Table 429. Suspended sediment concentration for control run without agitation duplicate C5 at Station 2('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4194	26.2737	27.0248	26.8882	0.6054	0.6145	2.4216	2.4580
2	31.4192	26.3094	31.9755	26.9158	0.5563	0.6064	2.2252	2.4256
3	31.3582	26.3473	31.9340	26.9403	0.5758	0.5930	2.3032	2.3720
4	26.2749	26.3147	26.8846	26.9392	0.6097	0.6245	2.4388	2.4980
5	26.4357	26.2916	27.0229	26.8770	0.5872	0.5854	2.3488	2.3416
6	26.5261	26.1859	26.8396	26.7434	0.3135	0.5575	1.2540	2.2300

Table 430. Suspended sediment concentration for control run without agitation duplicate C5 at Station 3('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	T	B	T	B	T	B	T	B
1	31.2166	31.3948	31.7671	31.9744	0.5505	0.5796	2.2020	2.3184
2	31.4003	31.4452	31.9503	32.0222	0.5500	0.5770	2.2000	2.3080
3	26.3027	26.2781	26.8656	26.8647	0.5629	0.5866	2.2516	2.3464
4	26.2920	31.4295	26.8324	31.9982	0.5404	0.5687	2.1616	2.2748
5	31.2711	26.2918	31.7027	26.8523	0.4316	0.5605	1.7264	2.2420
6	31.2231	26.2573	31.7622	26.8311	0.5391	0.5738	2.1564	2.2952

Table 431. Suspended sediment concentration for control run without agitation duplicate C5 at Station 4('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	T	B	T	B	T	B	T	B
1	31.1593	31.3181	31.7333	31.8422	0.5740	0.5241	2.2960	2.0964
2	31.4929	31.5461	32.0531	32.0724	0.5602	0.5263	2.2408	2.1052
3	26.4370	31.4106	26.8695	32.0024	0.4325	0.5918	1.7300	2.3672
4	31.5582	31.3596	31.9235	31.8235	0.3653	0.4639	1.4612	1.8556
5	26.4408	31.5818	26.9959	32.0884	0.5551	0.5066	2.2204	2.0264
6	31.7408	26.2868	32.0453	26.8755	0.3045	0.5887	1.2180	2.3548

Table 432. Suspended sediment concentration for control run without agitation duplicate at Station 5('-' indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3448	31.3982	26.9406	31.9780	0.5958	0.5798	2.3832	2.3192
2	26.3494	31.4257	26.9287	32.0374	0.5793	0.6117	2.3172	2.4468
3	31.4033	26.5407	31.9603	27.0305	0.5570	0.4898	2.2280	1.9594
4	26.2752	26.4989	26.8399	27.1304	0.5647	0.6315	2.2588	2.5260
5	31.1511	31.2859	31.7313	31.9915	0.5802	0.7056	2.3208	2.8224
6	26.3807	26.4312	26.9843	27.0418	0.6036	0.6106	2.4144	2.4424

Table 433. Suspended sediment concentration for control run without agitation duplicate C5 at Station 6('-' indicates no data available).

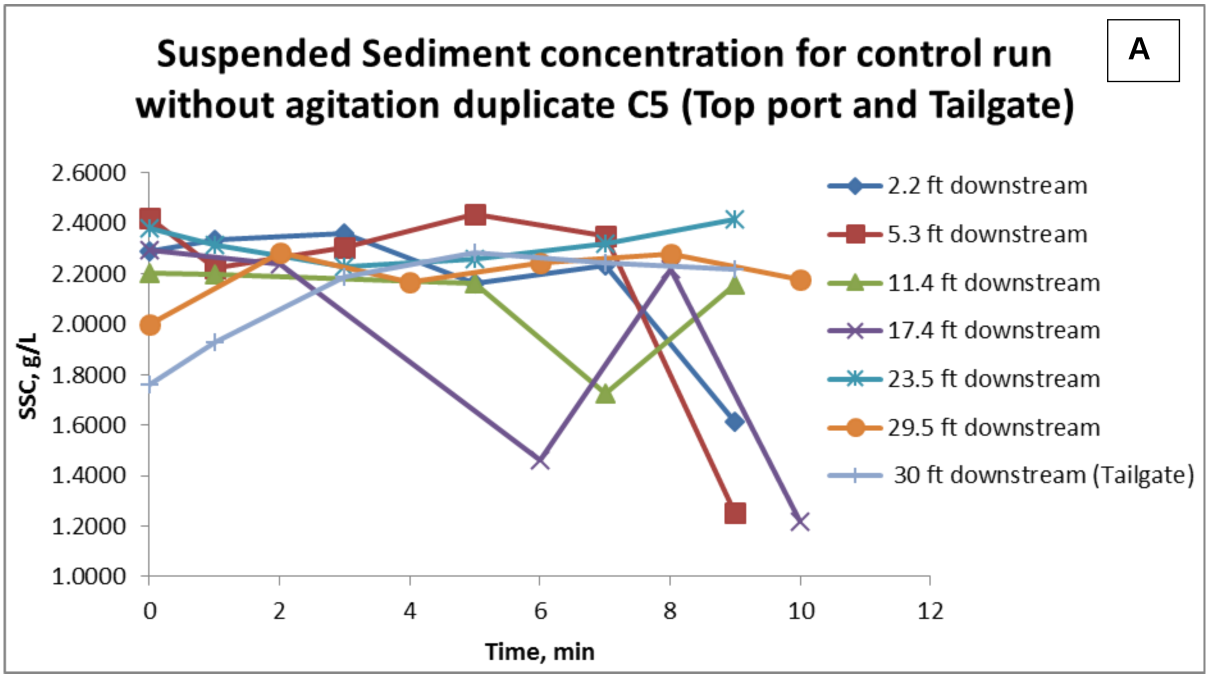
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2691	31.3666	26.7693	31.8481	0.5002	0.4815	2.0008	1.9260
2	26.4366	26.2885	27.0078	26.8718	0.5712	0.5833	2.2848	2.3332
3	31.4498	26.3351	31.9920	26.8921	0.5422	0.5570	2.1688	2.2280
4	26.3122	26.4092	26.8726	27.0203	0.5604	0.6111	2.2416	2.4444
5	26.2350	26.3978	26.8055	26.9878	0.5705	0.5900	2.2820	2.3600
6	31.5144	26.3419	32.0587	26.9013	0.5443	0.5594	2.1772	2.2376

Table 434. Suspended sediment concentration for control run without agitation duplicate C5 at tailgate('-' indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	31.4702	31.9100	0.4398	1.7592
2	26.4351	26.9180	0.4829	1.9316
3	31.5522	32.0990	0.5468	2.1872
4	31.4868	32.0580	0.5712	2.2848
5	26.2789	26.8399	0.5610	2.2440
6	31.1728	31.7281	0.5553	2.2212

Table 435. Mass of settled sediments in the trays for control run without agitation **duplicate C5.**

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	392.85	403.05	10.20
2	867.15	892.30	25.15
3	435.15	458.30	23.15
4	395.90	420.40	24.50
5	790.95	817.85	26.90
6	826.10	857.85	31.75
7	434.85	457.90	23.05
8	826.50	847.70	21.20
9	831.65	857.15	25.50
10	789.45	812.85	23.40
11	825.55	850.65	25.10



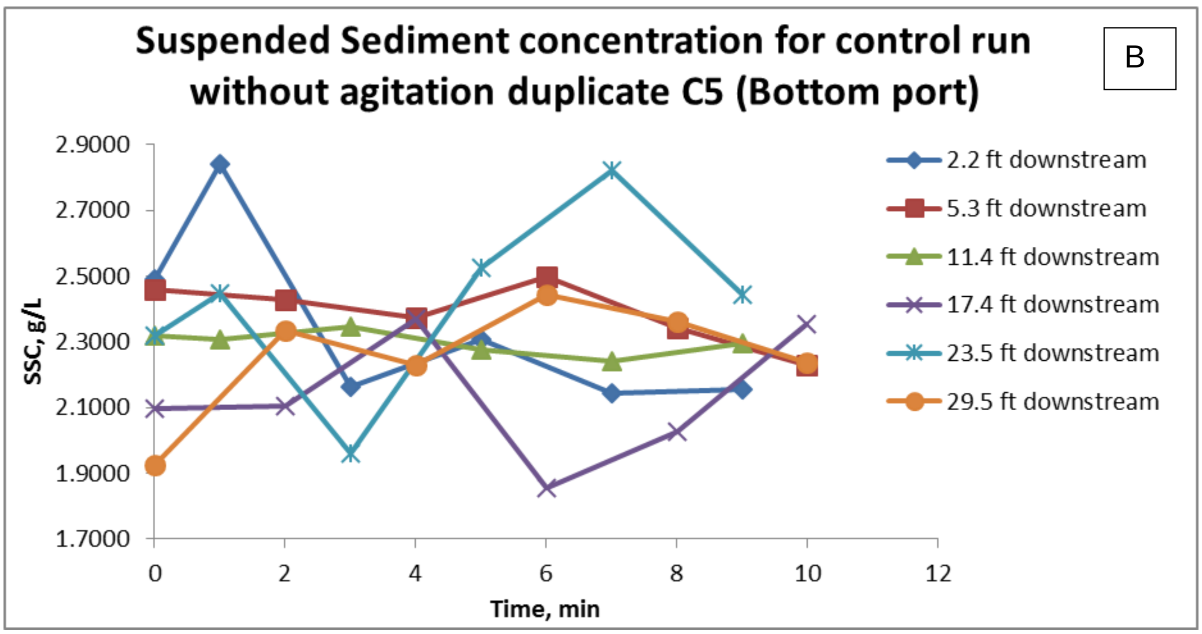


Figure 119. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

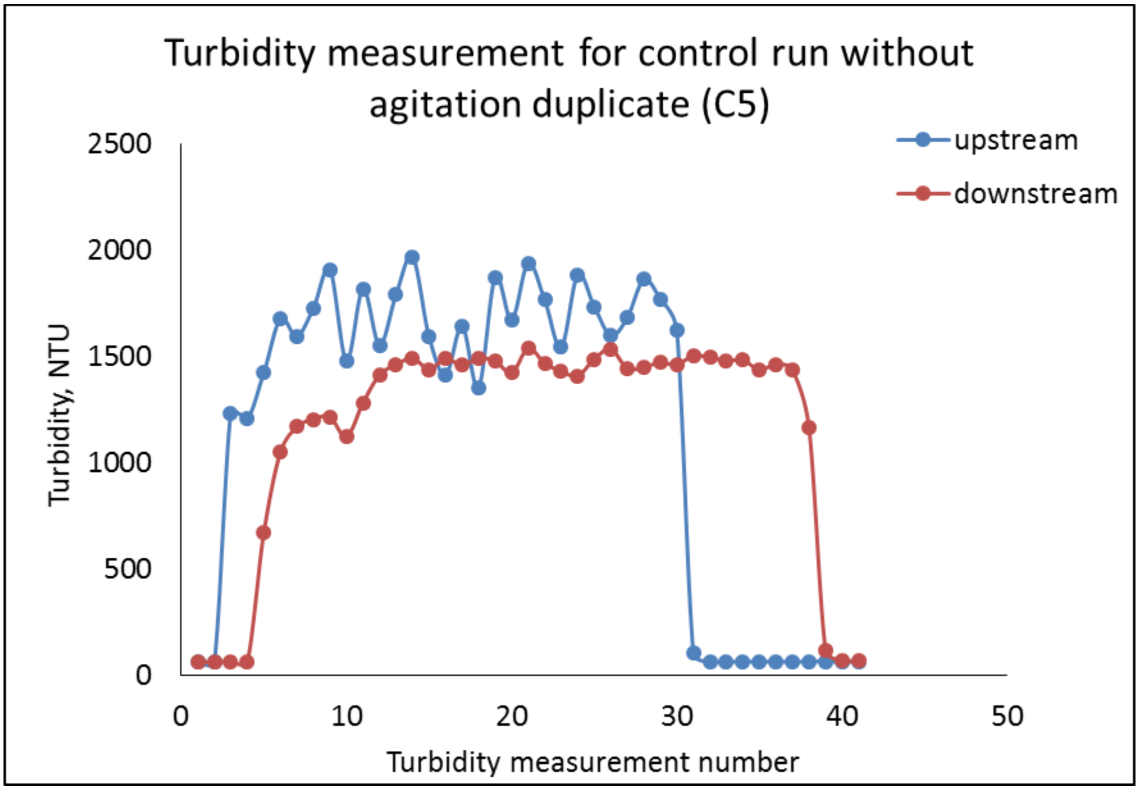


Figure 120. Upstream and downstream turbidity for control run without agitation duplicate C5. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

Stephenville High velocity gradient control Run Duplicate (C6)

The oscillating grid speed was set at 148 rpm. Tables 436 to 443 show the data related to this run, and Figure 121 shows the graph of the sediment concentration.

Table 436. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	T	B	T	B	T	B	T	B
1	26.3711	31.3491	26.9511	31.9471	0.5800	0.5980	2.3200	2.3920
2	26.3025	26.4894	26.9006	27.1260	0.5981	0.6366	2.3924	2.5464
3	26.3888	31.3918	26.9840	31.9908	0.5952	0.5990	2.3808	2.3960
4	31.3844	31.4000	31.9669	31.9883	0.5825	0.5883	2.3300	2.3532
5	31.3589	31.4438	31.9348	32.0459	0.5759	0.6021	2.3036	2.4084
6	26.4744	31.4733	27.0723	32.0716	0.5979	0.5983	2.3916	2.3932

Table 437. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	T	B	T	B	T	B	T	B
1	31.4569	26.4815	32.0335	27.0719	0.5766	0.5904	2.3064	2.3616
2	31.4373	31.4006	32.0211	31.9874	0.5838	0.5868	2.3352	2.3472
3	31.4252	31.4275	32.0017	32.0063	0.5765	0.5788	2.3060	2.3152
4	26.2368	26.3661	26.9611	26.8987	0.7243	0.5326	2.8972	2.1304
5	26.3983	31.4666	26.9807	32.0505	0.5824	0.5839	2.3296	2.3356
6	31.4282	26.2711	32.0052	26.8606	0.5770	0.5895	2.3080	2.3580

Table 438. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4810	31.4368	32.0549	32.0429	0.5739	0.6061	2.2956	2.4244
2	26.3348	31.4200	26.9206	31.9919	0.5858	0.5719	2.3432	2.2876
3	31.3858	26.2505	31.9484	26.8326	0.5626	0.5821	2.2504	2.3284
4	26.4293	26.3008	27.0251	26.8844	0.5958	0.5836	2.3832	2.3344
5	26.3865	31.3734	26.9821	31.9637	0.5956	0.5903	2.3824	2.3612
6	26.3650	26.4876	26.9429	27.0607	0.5779	0.5731	2.3116	2.2924

Table 439. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2368	26.2964	26.8118	26.8751	0.5750	0.5787	2.3000	2.3148
2	31.3844	26.4115	31.9492	27.0054	0.5648	0.5939	2.2592	2.3756
3	26.2946	26.2727	26.8970	26.4634	0.6024	0.1907	2.4096	0.7628
4	26.3851	31.3925	26.9765	31.9794	0.5914	0.5869	2.3656	2.3476
5	31.3806	26.2363	31.9278	26.8255	0.5472	0.5892	2.1888	2.3568
6	31.3690	26.4104	31.9164	26.9949	0.5474	0.5845	2.1896	2.3380

Table 440. Suspended sediment concentration for high velocity gradient control run C6 at Station 5(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2987	26.3041	26.8698	26.9343	0.5711	0.6302	2.2844	2.5208
2	26.4100	31.3291	26.9784	31.9245	0.5684	0.5954	2.2736	2.3816
3	26.2456	31.3883	26.8335	31.9785	0.5879	0.5902	2.3516	2.3608
4	26.2889	26.2606	26.8696	26.8688	0.5807	0.6082	2.3228	2.4328
5	26.2702	31.1575	26.8562	31.7329	0.5860	0.5754	2.3440	2.3016
6	26.3489	26.2687	26.9323	26.8730	0.5834	0.6043	2.3336	2.4172

Table 441. Suspended sediment concentration for high velocity gradient control run duplicate C6 at Station 6 (‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3737	26.4067	31.9478	26.9911	0.5741	0.5844	2.2964	2.3376
2	31.3521	31.3526	31.8968	31.9478	0.5447	0.5952	2.1788	2.3808
3	26.4873	26.2706	27.0464	26.8541	0.5591	0.5835	2.2364	2.3340
4	26.2611	31.3263	26.8359	31.9002	0.5748	0.5739	2.2992	2.2956
5	26.3877	26.4832	26.9626	27.0726	0.5749	0.5894	2.2996	2.3576
6	26.4369	26.4309	27.0010	27.0242	0.5641	0.5933	2.2564	2.3732

Table 442. Suspended sediment concentration for high velocity gradient control run duplicate C6 at tailgate (‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	sediment concentration (g/L)
1	26.3073	26.8680	0.5607	2.2428
2	26.5434	27.1091	0.5657	2.2628
3	26.3889	26.9418	0.5529	2.2116
4	26.5048	27.0516	0.5468	2.1872
5	26.2940	26.8411	0.5471	2.1884
6	26.2658	26.8147	0.5489	2.1956

Table 443. Mass of the sediment settled in the trays for high velocity gradient control run duplicate C6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	393.00	400.65	7.65
2	827.05	849.10	22.05
3	829.60	855.40	25.80
4	872.75	890.50	17.75
5	869.20	894.95	25.75
6	829.30	859.35	30.05
7	392.85	415.95	23.10
8	828.55	857.15	28.60
9	827.15	857.80	30.65
10	827.95	855.15	27.20
11	787.10	806.15	19.05

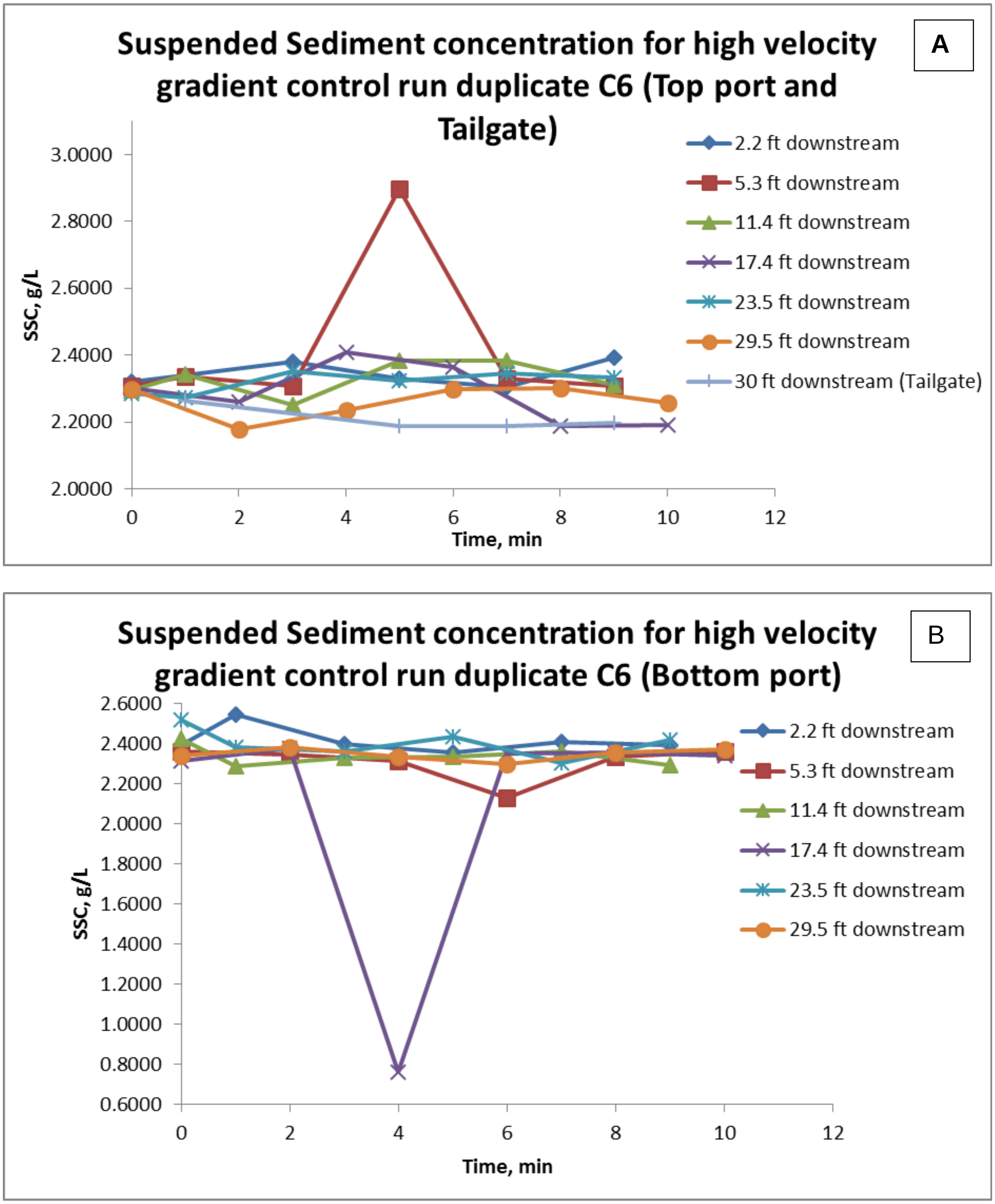


Figure 121. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

Norge B Low Velocity Gradient Flocculation Run (F1)

The oscillating grid speed was set at 99 rpm. Tables 444 to 451 show the data related to this run, and Figure 122 shows the graph of the sediment concentration. Figure 123 shows the graph of the upstream and downstream turbidity.

Table 444. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2568	26.2332	26.8500	26.8428	0.5932	0.6096	2.3728	2.4384
2	26.2641	26.4408	26.8409	27.0421	0.5768	0.6013	2.3072	2.4052
3	31.5506	31.3599	32.1038	31.9376	0.5532	0.5777	2.2128	2.3108
4	31.4566	31.4597	31.9919	32.0397	0.5353	0.5800	2.1412	2.3200
5	31.2352	26.3580	31.7916	26.9451	0.5564	0.5871	2.2256	2.3484
6	26.4179	26.2437	26.9900	26.8441	0.5721	0.6004	2.2884	2.4016

Table 445. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4684	31.1440	32.0157	31.6946	0.5473	0.5506	2.1892	2.2024
2	31.3511	31.3723	31.8998	31.9303	0.5487	0.5580	2.1948	2.2320
3	26.3760	26.2800	26.9214	26.8653	0.5454	0.5853	2.1816	2.3412
4	26.3490	26.2682	26.8120	26.8318	0.4630	0.5636	1.8520	2.2544
5	31.3830	31.3729	31.6907	31.9373	0.3077	0.5644	1.2308	2.2576
6	26.2540	31.4800	26.4772	32.0305	0.2232	0.5505	0.8928	2.2020

Table 446. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 3 (‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2605	26.4007	26.8037	26.9785	0.5432	0.5778	2.1728	2.3112
2	26.2855	26.4899	26.7237	27.0087	0.4382	0.5188	1.7526	2.0752
3	26.5116	26.5549	27.0001	27.0696	0.4885	0.5147	1.9540	2.0588
4	31.4125	31.4598	31.8815	31.9804	0.4690	0.5206	1.8760	2.0824
5	26.2530	26.3422	26.7325	26.8831	0.4795	0.5409	1.9180	2.1636
6	31.3589	26.4155	31.8620	26.9450	0.5031	0.5295	2.0124	2.1180

Table 447. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 4 (‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2776	26.4527	26.8463	27.0488	0.5687	0.5961	2.2748	2.3844
2	26.3233	31.2309	26.5171	31.5557	0.1938	0.3248	0.7752	1.2992
3	26.3032	31.4487	26.5128	31.7955	0.2096	0.3468	0.8384	1.3872
4	31.4351	31.5319	31.6284	31.8795	0.1933	0.3476	0.7732	1.3904
5	31.4612	26.2870	31.6486	26.6565	0.1874	0.3695	0.7496	1.4780
6	26.4414	31.3850	26.6550	31.7521	0.2136	0.3671	0.8544	1.4684

Table 448. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 5 ('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4588	31.1682	32.0118	31.7324	0.5530	0.5642	2.2120	2.2568
2	26.4821	31.4065	26.7615	31.9636	0.2794	0.5571	1.1176	2.2284
3	31.4756	31.5134	31.6308	31.7367	0.1552	0.2233	0.6208	0.8932
4	31.4002	31.4482	31.5611	31.6909	0.1609	0.2427	0.6436	0.9708
5	26.2888	26.2802	26.4602	26.5329	0.1714	0.2527	0.6856	1.0108
6	31.4447	31.4829	31.6065	31.7104	0.1618	0.2275	0.6472	0.9100

Table 449. Suspended sediment concentration for low velocity gradient flocculation run F1 at Station 6 ('-'indicates No data available).

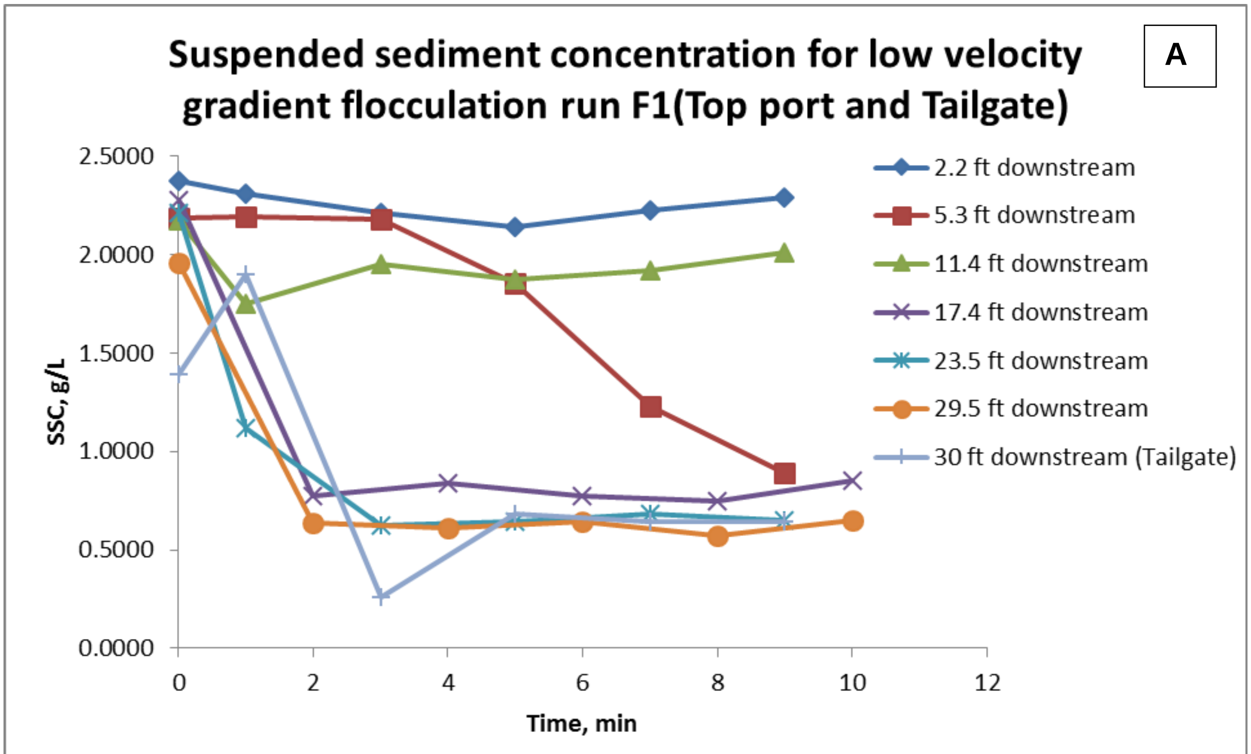
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2810	31.4863	26.7712	32.0186	0.4902	0.5323	1.9608	2.1292
2	31.2485	31.4938	31.4074	31.8064	0.1589	0.3126	0.6356	1.2504
3	31.4237	31.4550	31.5758	31.6463	0.1521	0.1913	0.6084	0.7652
4	26.3988	26.5210	26.5595	26.7187	0.1607	0.1977	0.6428	0.7908
5	31.3946	31.4154	31.5369	31.6019	0.1423	0.1865	0.5692	0.7460
6	31.5299	26.4855	31.6925	26.7001	0.1626	0.2146	0.6504	0.8584

Table 450. Suspended sediment concentration for low velocity gradient flocculation run F1 at tailgate (‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.3523	26.7009	0.3486	1.3944
2	26.4150	26.8905	0.4755	1.9020
3	26.3943	26.4590	0.0647	0.2588
4	26.2876	26.4586	0.1710	0.6840
5	31.2742	31.4348	0.1606	0.6424
6	26.4131	26.5743	0.1612	0.6448

Table 451. Mass of the sediment settled in the trays for low velocity gradient flocculation run F1.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	73.00	81.80	8.80
2	74.70	130.55	55.85
3	69.30	169.45	100.15
4	145.25	475.30	330.05
5	147.90	567.45	419.55
6	139.85	879.25	739.40
7	140.00	560.80	420.80
8	148.20	486.10	337.90
9	143.55	248.45	104.90
10	139.50	281.50	142.00
11	144.45	201.75	57.30



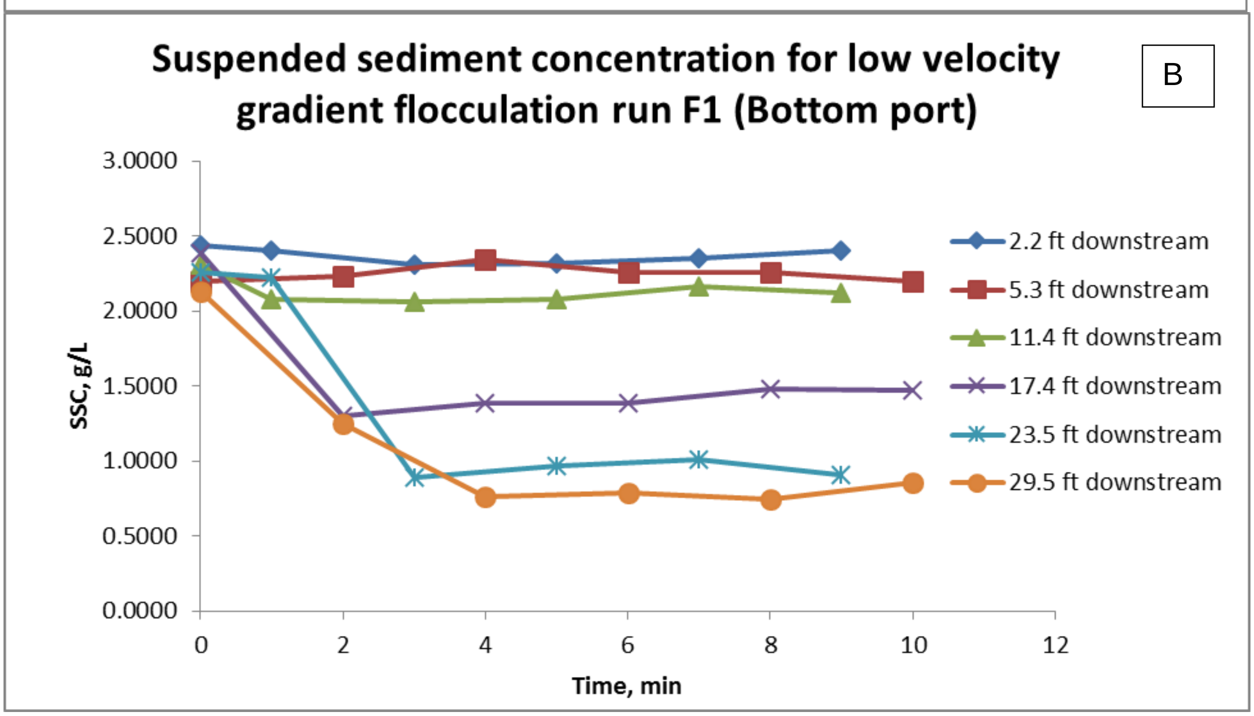


Figure 122. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.

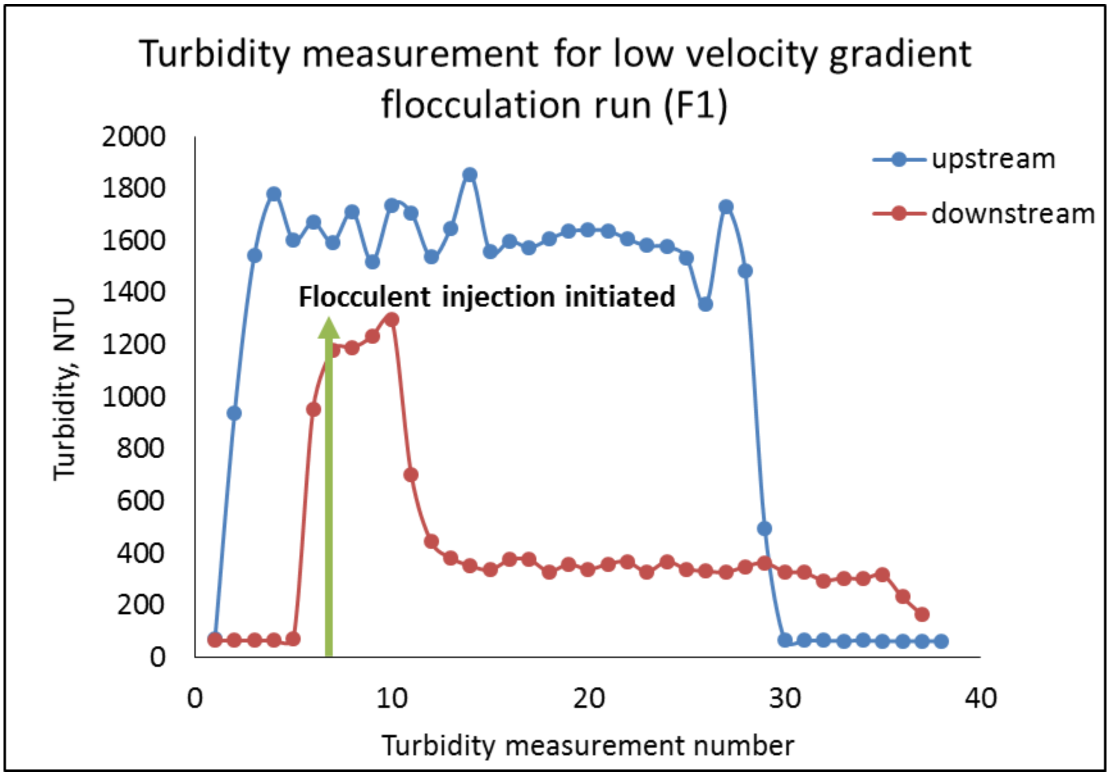


Figure 123. Upstream and downstream turbidity for low velocity gradient flocculation run F1. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

Stephenville B High Velocity Gradient Flocculation Run (F2)

The oscillating grid speed was set at 148 rpm. Tables 452 to 459 show the data related to this run, and Figure 124 shows the graph of the sediment concentration. Figure 125 shows the graph of the upstream and downstream turbidity.

Table 452. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3274	31.4500	26.8435	31.9820	0.5161	0.5320	2.0644	2.1280
2	26.4633	31.3265	26.9281	31.8416	0.4648	0.5151	1.8592	2.0604
3	26.3892	26.3637	26.8996	26.9029	0.5104	0.5392	2.0416	2.1568
4	26.4500	31.2296	26.9741	31.7631	0.5241	0.5335	2.0964	2.1340
5	31.3601	26.3067	31.8608	26.8548	0.5007	0.5481	2.0028	2.1924
6	26.3960	26.3373	26.9537	26.8958	0.5577	0.5585	2.2308	2.2340

Table 453. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.2791	31.4838	26.8090	32.0049	0.5299	0.5211	2.1196	2.0844
2	26.3309	31.1497	26.8510	31.6779	0.5201	0.5282	2.0804	2.1128
3	31.3705	26.3465	31.8740	26.8918	0.5035	0.5453	2.0140	2.1812
4	26.4866	31.4747	27.0000	31.9874	0.5134	0.5127	2.0536	2.0508
5	31.4264	31.3824	31.7967	31.9049	0.3703	0.5225	1.4812	2.0900
6	26.2363	31.4180	26.6949	31.9475	0.4586	0.5295	1.8344	2.1180

Table 454. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5150	26.3233	31.9599	26.6748	0.4449	0.3515	1.7796	1.4060
2	26.4159	31.3599	26.8382	31.8502	0.4223	0.4903	1.6892	1.9612
3	26.4773	26.3840	26.9099	26.9151	0.4326	0.5311	1.7304	2.1244
4	26.3133	26.3360	26.7116	26.8639	0.3983	0.5279	1.5932	2.1116
5	31.3989	26.3200	31.8025	26.9031	0.4036	0.5831	1.6144	2.3324
6	31.3880	31.2013	31.8006	31.7430	0.4126	0.5417	1.6504	2.1668

Table 455. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3483	26.4019	26.5787	26.8669	0.2304	0.4650	0.9216	1.8600
2	31.5401	31.4701	31.7439	31.8265	0.2038	0.3564	0.8152	1.4256
3	31.4486	26.2743	31.6660	26.6513	0.2174	0.3770	0.8696	1.5080
4	31.3586	26.4716	31.5642	26.8640	0.2056	0.3924	0.8224	1.5696
5	26.2946	31.4695	26.5027	31.8329	0.2081	0.3634	0.8324	1.4536
6	31.4001	26.5010	31.6191	26.9321	0.2190	0.4311	0.8760	1.7244

Table 456. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3958	26.3798	26.7099	26.8917	0.3141	0.5119	1.2564	2.0476
2	26.2675	26.3179	26.4333	26.5526	0.1658	0.2347	0.6632	0.9388
3	31.4704	26.2522	31.6350	26.5037	0.1646	0.2515	0.6584	1.0060
4	26.3833	26.4216	26.5600	26.6709	0.1767	0.2493	0.7068	0.9972
5	31.4785	26.3190	31.6600	26.5790	0.1815	0.2600	0.7260	1.0400
6	26.3986	26.2427	26.5831	26.4900	0.1845	0.2473	0.7380	0.9892

Table 457. Suspended sediment concentration for high velocity gradient flocculation run F2 at Station 6('-'indicates No data available).

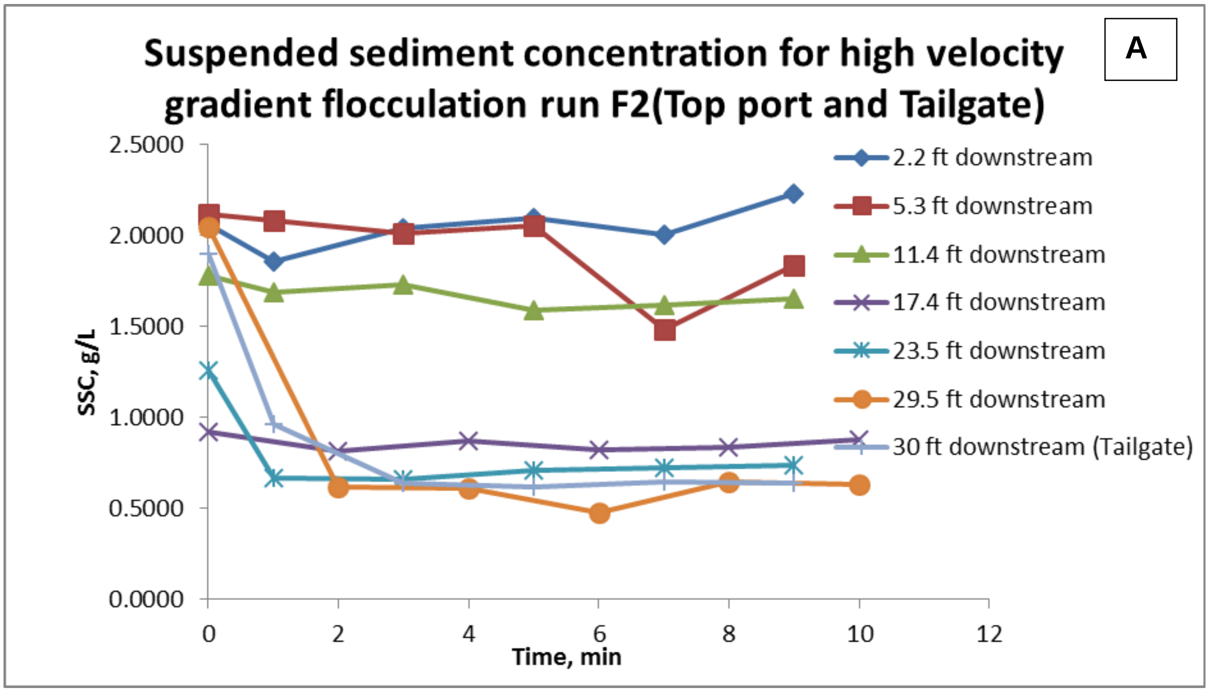
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.4676	31.3839	31.9800	31.8421	0.5124	0.4582	2.0496	1.8328
2	31.4250	31.2310	31.5784	31.4193	0.1534	0.1883	0.6136	0.7532
3	26.4191	31.1975	26.5723	31.3830	0.1532	0.1855	0.6128	0.7420
4	26.3012	31.3678	26.4209	31.5585	0.1197	0.1907	0.4788	0.7628
5	26.4475	26.2947	26.6088	26.4884	0.1613	0.1937	0.6452	0.7748
6	26.2612	26.3067	26.4190	26.5001	0.1578	0.1934	0.6312	0.7736

Table 458. Suspended sediment concentration for high velocity gradient flocculation run F2 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	sediment weight (g)	Sediment concentration (g/L)
0	31.4559	31.9302	0.4743	1.8972
1	26.3048	26.5454	0.2406	0.9624
3	26.5048	26.6637	0.1589	0.6356
5	31.2286	31.3832	0.1546	0.6184
7	26.4532	26.6146	0.1614	0.6456
9	31.4020	31.5609	0.1589	0.6356

Table 459. Mass of the sediment settled in the trays for high velocity gradient flocculation run F2

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	70.10	84.00	13.90
2	74.40	150.55	76.15
3	72.50	162.45	89.95
4	146.85	380.30	233.45
5	217.45	873.70	656.25
6	211.75	988.25	776.50
7	139.70	624.75	485.05
8	146.40	400.95	254.55
9	143.50	299.00	155.50
10	70.30	251.55	181.25
11	69.65	106.80	37.15



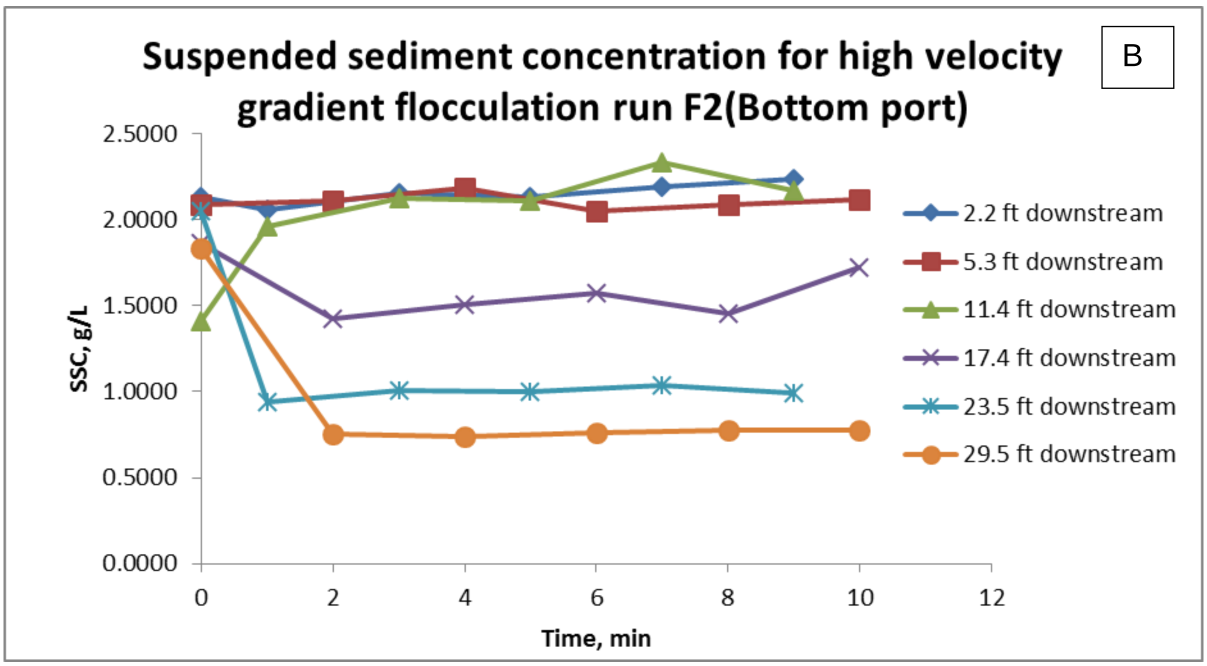


Figure 124. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 7 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

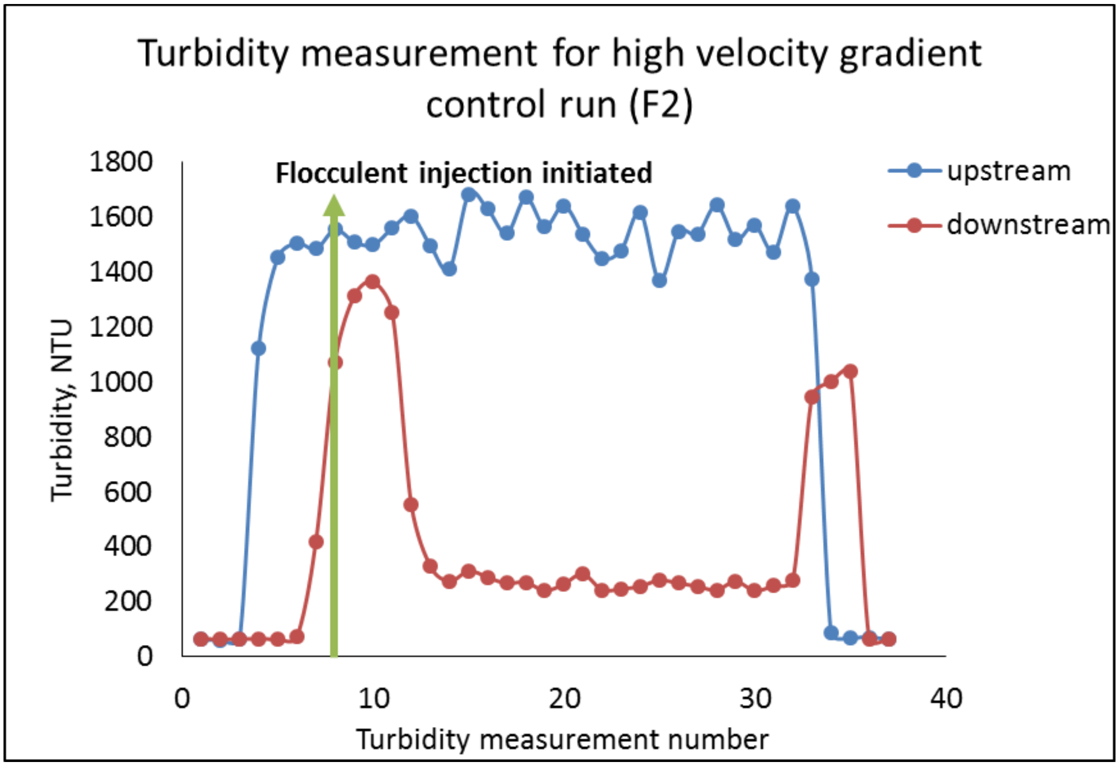


Figure 125. Upstream and downstream turbidity for control run without agitation C1. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

<u>Stephenville B Low Velocity Gradient Flocculation Run Duplicate (F3)</u>

The oscillating grid speed was set at 99 rpm. Tables 460 to 467 show the data related to this run, and Figure 126 shows the graph of the sediment concentration. Figure 127 shows the graph of the upstream and downstream turbidity.

Table 460. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5108	26.2868	26.8882	26.8586	0.3774	0.5718	1.5096	2.2872
2	31.2518	26.2847	31.7895	26.8654	0.5377	0.5807	2.1508	2.3228
3	26.1989	26.3782	26.7628	26.8330	0.5639	0.4548	2.2556	1.8192
4	26.3900	26.3488	27.0068	26.8042	0.6168	0.4554	2.4672	1.8216
5	26.3766	26.2610	26.9428	26.8482	0.5662	0.5872	2.2648	2.3488
6	26.2939	26.5014	26.8412	26.9300	0.5473	0.4286	2.1892	1.7144

Table 461. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4942	26.4111	26.7787	26.8416	0.2845	0.4305	1.1380	1.7220
2	26.3177	26.4678	26.8579	27.0400	0.5402	0.5722	2.1608	2.2888
3	26.3456	26.6368	26.8683	27.0437	0.5227	0.4069	2.0908	1.6276
4	26.3959	31.4699	26.8961	32.0669	0.5002	0.5970	2.0008	2.3880
5	26.4082	26.4453	26.8709	26.8301	0.4627	0.3848	1.8508	1.5392
6	26.2556	26.4002	26.6369	26.9490	0.3813	0.5488	1.5252	2.1952

Table 462. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 3(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3635	26.4910	26.8415	27.0086	0.4780	0.5176	1.9120	2.0704
2	31.4485	26.3809	31.7270	26.9465	0.2785	0.5656	1.1140	2.2624
3	26.3612	26.5820	26.7775	26.7946	0.4163	0.2126	1.6652	0.8504
4	26.3453	31.5298	26.6442	31.9238	0.2989	0.3940	1.1956	1.5760
5	26.4200	26.3679	26.8117	26.8406	0.3917	0.4727	1.5668	1.8908
6	26.5028	26.2652	26.9765	26.8349	0.4737	0.5697	1.8948	2.2788

Table 463. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 4(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3126	26.4790	26.7732	26.8419	0.4606	0.3629	1.8424	1.4516
2	31.4207	26.4983	31.4825	26.7717	0.0618	0.2734	0.2472	1.0936
3	26.3519	26.4517	26.5177	26.7273	0.1658	0.2756	0.6632	1.1024
4	26.2092	26.4988	26.5984	26.6262	0.3892	0.1274	1.5568	0.5096
5	31.4205	26.4938	31.5849	26.6567	0.1644	0.1629	0.6576	0.6516
6	26.2933	26.2782	26.4783	26.6095	0.1850	0.3313	0.7400	1.3252

Table 464. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3957	26.2610	26.9874	26.8471	0.5917	0.5861	2.3668	2.3444
2	26.3353	26.4732	26.5439	27.0419	0.2086	0.5687	0.8344	2.2748
3	26.2564	26.2241	26.4116	26.4403	0.1552	0.2162	0.6208	0.8648
4	26.4267	26.2899	26.5416	26.5136	0.1149	0.2237	0.4596	0.8948
5	26.4449	26.2438	26.4449	26.6057	0.0000	0.3619	0.0000	1.4476
6	26.2704	26.3861	26.4301	26.4707	0.1597	0.0846	0.6388	0.3384

Table 465. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at Station 6('-'indicates No data available).

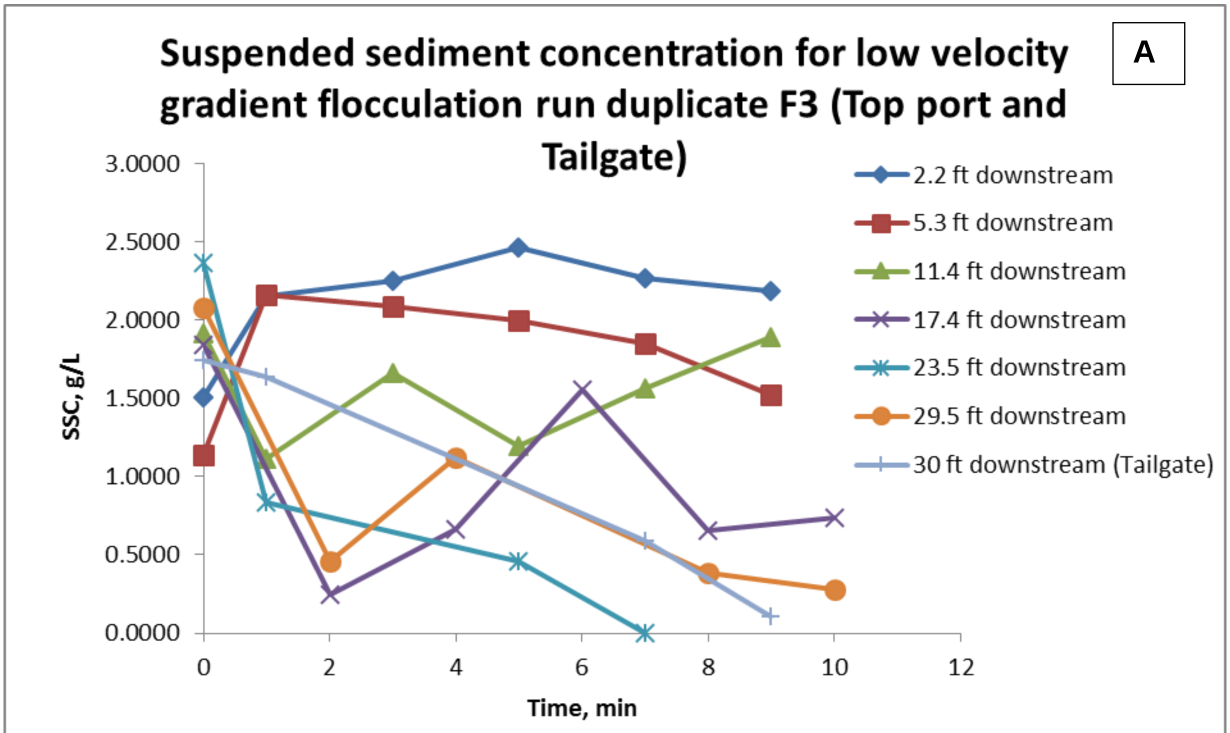
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3762	26.4130	26.8961	26.9885	0.5199	0.5755	2.0796	2.3020
2	26.4042	31.4021	26.5195	31.7831	0.1153	0.3810	0.4612	1.5240
3	26.3401	26.4392	26.6201	26.6323	0.2800	0.1931	1.1200	0.7724
4	26.3330	26.5386	26.4421	26.6923	0.1091	0.1537	0.4364	0.6148
5	26.3695	26.2498	26.4648	26.4570	0.0953	0.2072	0.3812	0.8288
6	26.5426	26.3338	26.6126	26.5010	0.0700	0.1672	0.2800	0.6688

Table 466. Suspended sediment concentration for low velocity gradient flocculation run duplicate F3 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration g/L
1	26.3995	26.8364	0.4369	1.7476
2	26.6515	27.0617	0.4102	1.6408
3	26.3604	26.4427	0.0823	0.3292
4	26.4964	26.5193	0.0229	0.0916
5	26.2965	26.4443	0.1478	0.5912
6	26.7752	26.8019	0.0267	0.1068

Table 467. Mass of the sediment settled in the trays for low velocity gradient flocculation run duplicate F3.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.05	442.95	9.90
2	759.10	822.90	63.80
3	759.90	909.25	149.35
4	1520.05	2030.25	510.20
5	2278.45	3193.50	915.05
6	2277.80	3088.75	810.95
7	1518.80	2061.95	543.15
8	1519.20	1811.45	292.25
9	1518.95	1646.30	127.35
10	1518.75	1588.80	70.05
11	1519.75	1574.65	54.90



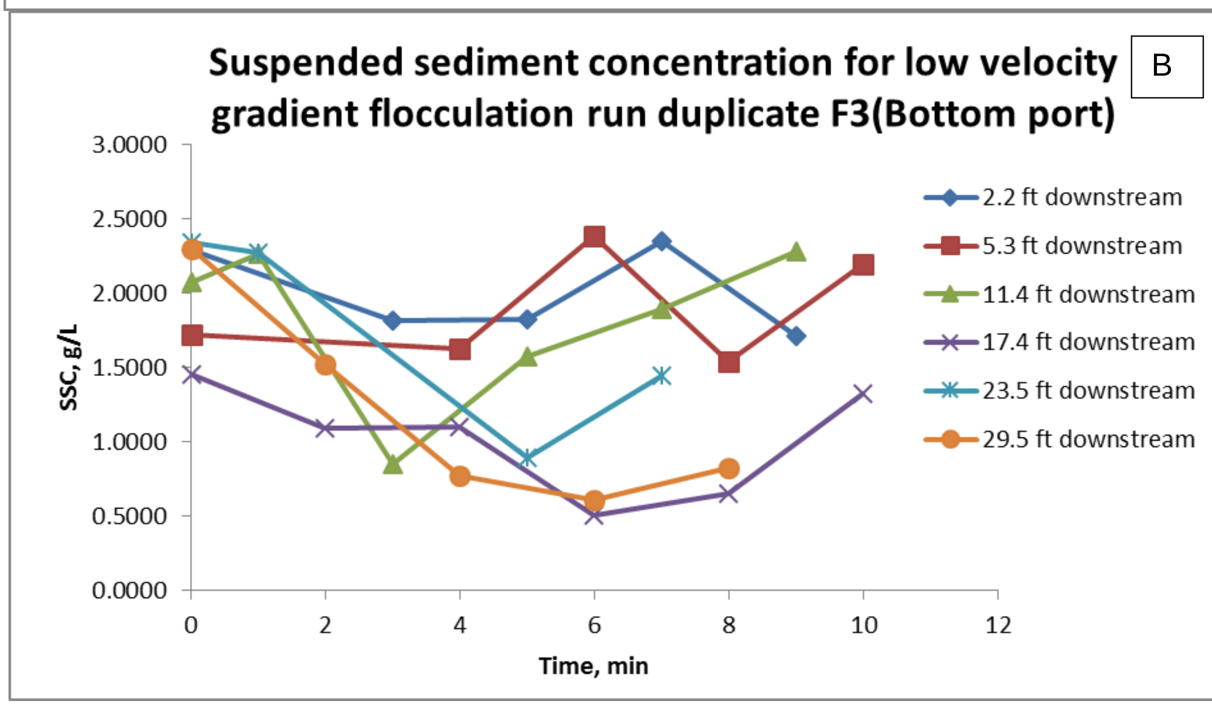


Figure 126. Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

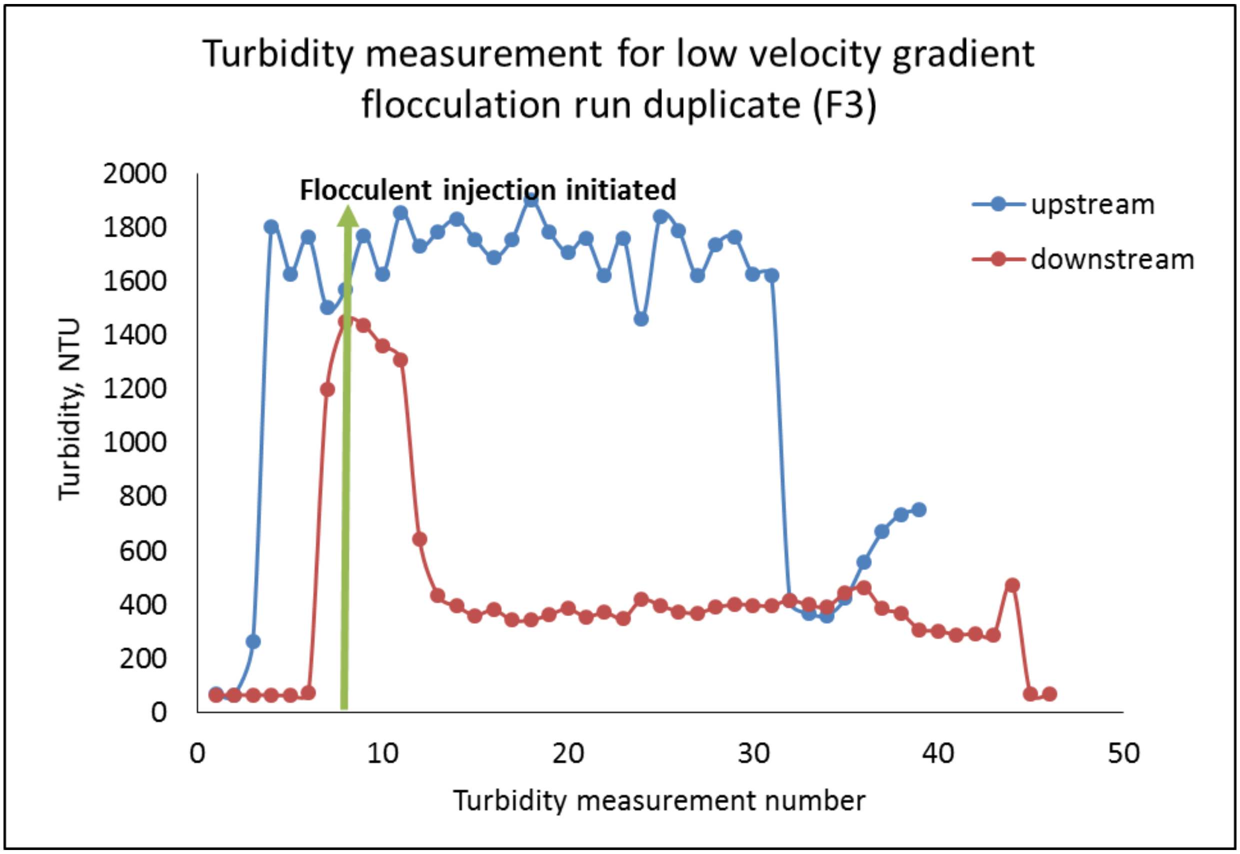


Figure 127. Upstream and downstream turbidity for low velocity gradient flocculation run duplicate F3. The turbidity measurement number indicates every 30-second time interval after which the turbidity reading was recorded by the instrument.

<u>Stephenville B High Velocity Gradient Flocculation Run Duplicate (F4)</u>

The oscillating grid speed was set at 148 rpm. Tables 468 to 475 show the data related to this run, and Figure 128 shows the graph of the sediment concentration. Figure 129 shows the graph of the upstream and downstream turbidity.

Table 468. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 1('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3587	26.4023	26.8828	26.8352	0.5241	0.4329	2.0964	1.7316
2	26.3111	31.4686	26.8346	31.9548	0.5235	0.4862	2.0940	1.9448
3	26.4571	26.3278	26.9126	26.8864	0.4555	0.5586	1.8220	2.2344
4	26.3578	26.4376	26.8028	26.8297	0.4450	0.3921	1.7800	1.5684
5	26.4622	26.3448	26.9777	26.8621	0.5155	0.5173	2.0620	2.0692
6	26.3561	26.3194	26.9075	26.8188	0.5514	0.4994	2.2056	1.9976

Table 469. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 2('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4482	26.5780	26.7586	27.0206	0.3104	0.4426	1.2416	1.7704
2	26.2969	26.4260	26.8173	26.9581	0.5204	0.5321	2.0816	2.1284
3	26.4897	26.3888	26.9421	26.8435	0.4524	0.4547	1.8096	1.8188
4	31.3793	26.2704	31.8656	26.8280	0.4863	0.5576	1.9452	2.2304
5	26.5298	26.2513	27.0098	26.7935	0.4800	0.5422	1.9200	2.1688
6	26.3151	26.5002	26.8103	27.0607	0.4952	0.5605	1.9808	2.2420

Table 470. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 3('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.5061	26.4370	26.6521	26.8011	0.1460	0.3641	0.5840	1.4564
2	26.4119	26.5147	26.7272	27.0131	0.3153	0.4984	1.2612	1.9936
3	26.5548	26.2627	26.6401	26.7229	0.0853	0.4602	0.3412	1.8408
4	26.3992	26.3668	26.6313	26.7787	0.2321	0.4119	0.9284	1.6476
5	26.4864	26.4054	26.6571	26.8691	0.1707	0.4637	0.6828	1.8548
6	26.4797	31.5038	26.7148	32.0200	0.2351	0.5162	0.9404	2.0648

Table 471. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 4('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3226	26.4545	31.5962	26.9405	0.2736	0.4860	1.0944	1.9440
2	26.3063	26.3073	26.5013	26.5839	0.1950	0.2766	0.7800	1.1064
3	26.3708	26.3158	26.5292	26.6276	0.1584	0.3118	0.6336	1.2472
4	26.2886	26.4026	26.4407	26.6404	0.1521	0.2378	0.6084	0.9512
5	26.4091	26.5002	26.6419	26.7557	0.2328	0.2555	0.9312	1.0220
6	26.3662	26.5189	26.5178	26.6738	0.1516	0.1549	0.6064	0.6196

Table 472. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 5('-'indicates no data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.6190	26.6588	26.9004	26.8111	0.2814	0.1523	1.1256	0.6092
2	31.4533	26.5814	31.5754	26.8027	0.1221	0.2213	0.4884	0.8852
3	31.5188	26.3900	31.5663	26.5960	0.0475	0.2060	0.1900	0.8240
4	31.2653	26.4342	31.4139	26.5708	0.1486	0.1366	0.5944	0.5464
5	26.4665	26.3892	26.5941	26.5802	0.1276	0.1910	0.5104	0.7640
6	26.2818	26.2735	26.4560	26.4817	0.1742	0.2082	0.6968	0.8328

Table 473. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at Station 6('-'indicates no data available).

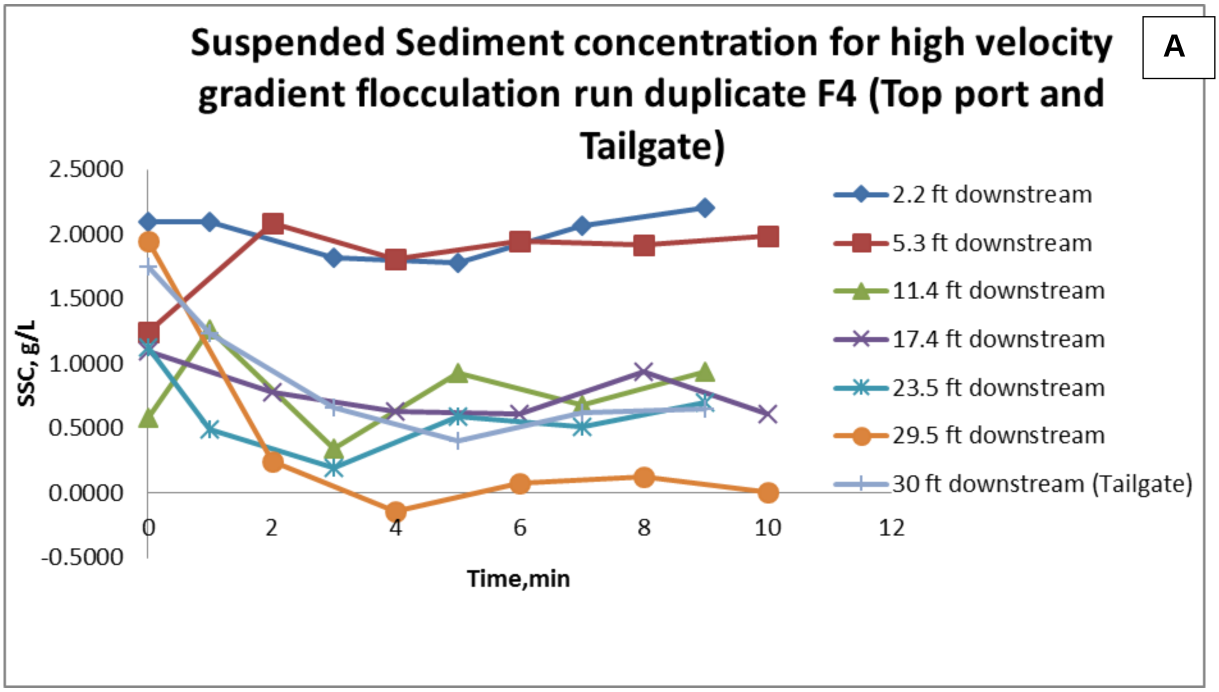
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.4065	26.2712	26.8920	26.7691	0.4855	0.4979	1.9420	1.9916
2	31.5083	26.4502	31.5693	26.5294	0.0610	0.0792	0.2440	0.3168
3	26.4863	26.4875	26.4498	26.6729	-0.0365	0.1854	-0.1460	0.7416
4	26.5615	26.3042	26.5809	26.5008	0.0194	0.1966	0.0776	0.7864
5	26.3865	26.4609	26.4175	26.4635	0.0310	0.0026	0.1240	0.0104
6	26.5632	26.6006	26.5633	26.6438	0.0001	0.0432	0.0004	0.1728

Table 474. Suspended sediment concentration for high velocity gradient flocculation run duplicate F4 at tailgate(‘-‘indicates no data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
0	26.4752	26.9126	0.4374	1.7496
1	26.4938	26.8027	0.3089	1.2356
3	26.3428	26.5065	0.1637	0.6548
5	26.4068	26.5067	0.0999	0.3996
7	26.2439	26.3987	0.1548	0.6192
9	26.2917	26.4538	0.1621	0.6484

Table 475. Mass of the sediment settled in the trays for high velocity gradient flocculation run duplicate F4.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	75.10	86.60	11.50
2	74.70	156.65	81.95
3	68.30	198.20	129.90
4	831.20	1203.75	372.55
5	224.50	952.05	727.55
6	217.60	983.15	765.55
7	139.80	531.25	391.45
8	73.65	715.65	642.00
9	143.45	270.70	127.25
0	139.30	229.60	90.30
11	144.85	215.40	70.55



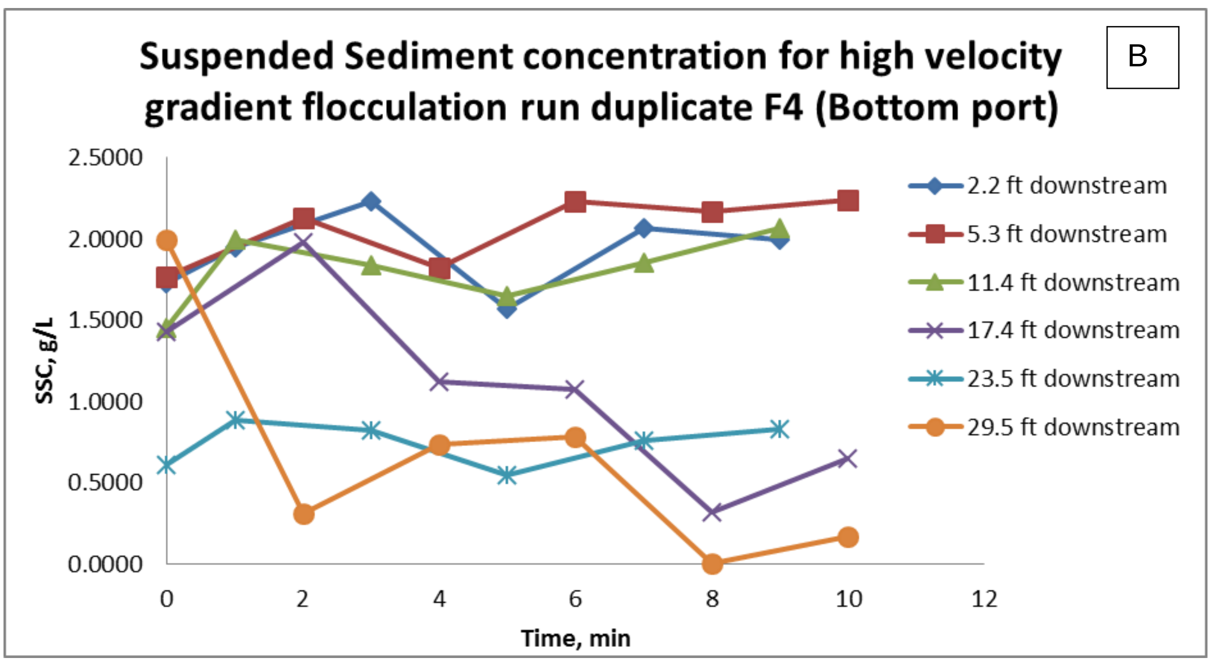


Figure 128: **Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately.**

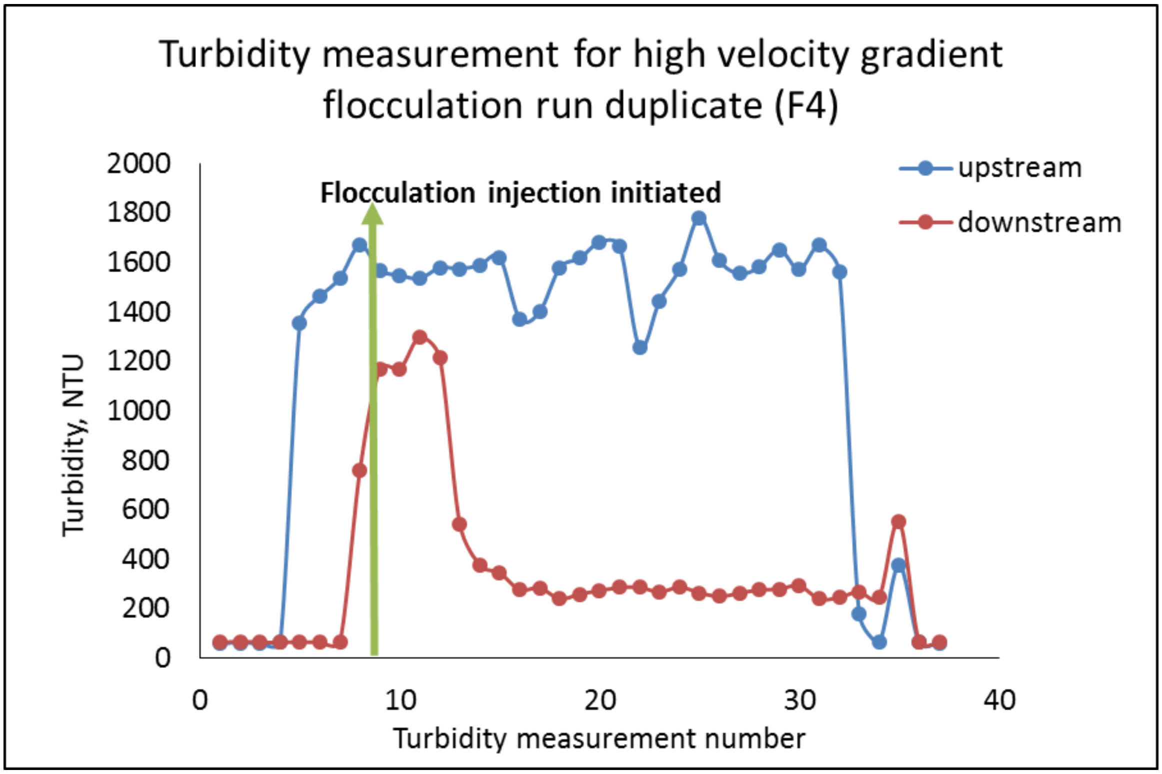


Figure 129. Upstream and downstream turbidity for high velocity gradient flocculation run duplicate F4. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument

<u>Stephenville B Low Velocity Gradient Flocculation Run Triplicate (F5)</u>

The oscillating grid speed was set at 99 rpm. Tables 476 to 483 show the data related to this run, and Figure 130 shows the graph of the sediment concentration. Figure 131 shows the graph of the upstream and downstream turbidity.

Table 476: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3261	31.4811	26.8340	31.9734	0.5079	0.4923	2.0316	1.9692
2	26.4583	31.3944	26.9450	31.8523	0.4867	0.4579	1.9468	1.8316
3	26.4118	26.3744	26.9390	26.9051	0.5272	0.5307	2.1088	2.1228
4	26.4216	31.2369	27.0033	31.7908	0.5817	0.5539	2.3268	2.2156
5	31.3710	26.3891	31.9123	26.8757	0.5413	0.4866	2.1652	1.9464
6	26.3981	26.3619	26.9614	26.8889	0.5633	0.5270	2.2532	2.1080

Table 477: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3328	31.5720	26.7457	31.9786	0.4129	0.4066	1.6516	1.6264
2	26.3322	31.1952	26.8546	31.7095	0.5224	0.5143	2.0896	2.0572
3	31.3829	26.3678	31.8858	26.8670	0.5029	0.4992	2.0116	1.9968
4	26.4401	31.3315	27.0237	31.9901	0.5836	0.6586	2.3344	2.6344
5	31.5333	31.4031	32.0386	31.9098	0.5053	0.5067	2.0212	2.0268
6	26.2689	31.3643	26.7677	31.9451	0.4988	0.5808	1.9952	2.3232

Table 478: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 3(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.3808	26.3174	31.7986	26.8259	0.4178	0.5085	1.6712	2.0340
2	26.3367	31.3857	26.6015	31.8262	0.2648	0.4405	1.0592	1.7620
3	26.4296	26.3861	26.6898	26.9050	0.2602	0.5189	1.0408	2.0756
4	26.3419	26.3977	26.5520	26.8709	0.2101	0.4732	0.8404	1.8928
5	31.5807	26.2730	31.6449	26.9116	0.0642	0.6386	0.2568	2.5544
6	31.4671	31.3344	31.6375	32.0403	0.1704	0.7059	0.6816	2.8236

Table 479: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 4(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3501	26.4105	26.8096	26.9714	0.4595	0.5609	1.8380	2.2436
2	31.5507	31.4761	31.6804	31.7009	0.1297	0.2248	0.5188	0.8992
3	31.5691	26.2833	31.6050	26.5167	0.0359	0.2334	0.1436	0.9336
4	31.5608	26.4781	31.7039	26.7092	0.1431	0.2311	0.5724	0.9244
5	26.3081	31.4865	26.4468	31.6962	0.1387	0.2097	0.5548	0.8388
6	31.4420	26.4068	31.5485	26.7378	0.1065	0.3310	0.4260	1.3240

Table 480: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 5(‘-‘indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3938	26.3812	26.8686	26.9521	0.4748	0.5709	1.8992	2.2836
2	26.2816	26.3231	26.4393	26.7944	0.1577	0.4713	0.6308	1.8852
3	31.4801	26.2859	31.5913	26.4331	0.1112	0.1472	0.4448	0.5888
4	26.3953	26.4339	26.5023	26.5980	0.1070	0.1641	0.4280	0.6564
5	31.5371	26.3306	31.6071	26.5070	0.0700	0.1764	0.2800	0.7056
6	26.3998	26.2433	26.5207	26.4246	0.1209	0.1813	0.4836	0.7252

Table 481: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at Station 6(‘-‘indicates No data available).

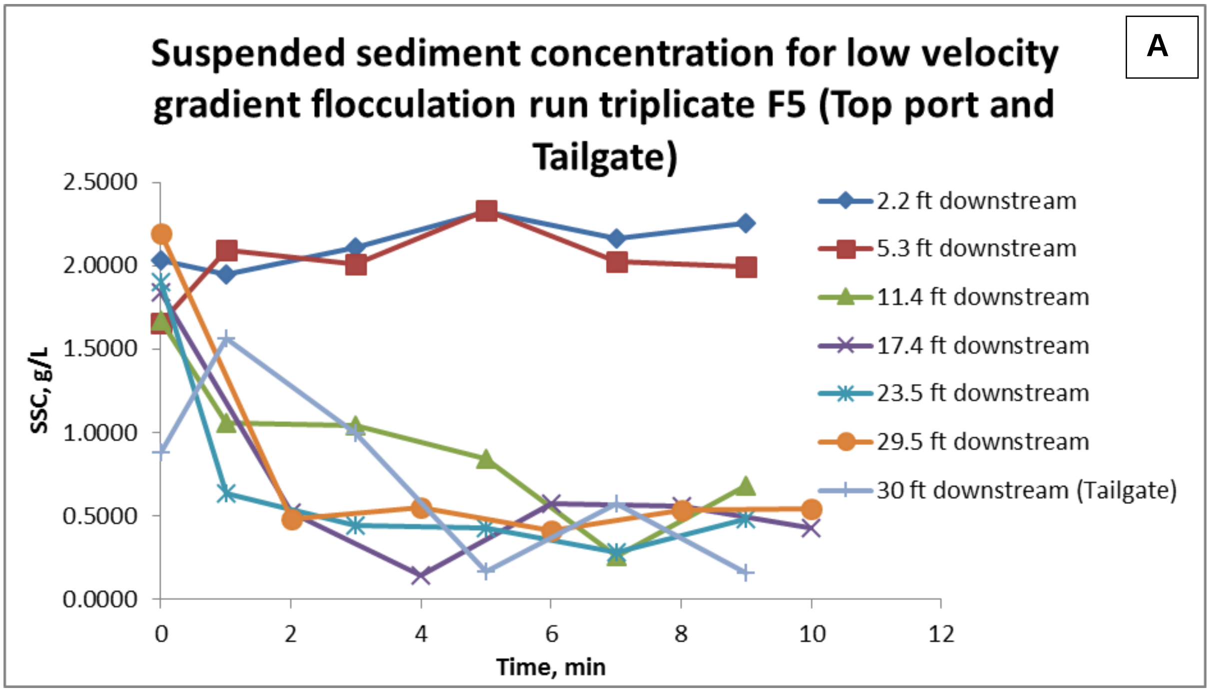
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.5045	31.4177	32.0518	31.7766	0.5473	0.3589	2.1892	1.4356
2	31.4646	31.2366	31.5856	31.6507	0.1210	0.4141	0.4842	1.6564
3	26.4268	31.2254	26.5633	31.3875	0.1365	0.1621	0.5460	0.6484
4	26.2957	31.4794	26.3982	31.5424	0.1025	0.0630	0.4100	0.2520
5	26.4580	26.3936	26.5912	26.4922	0.1332	0.0986	0.5328	0.3944
6	26.2731	26.3235	26.4081	26.4861	0.1350	0.1626	0.5400	0.6504

Table 482: Suspended sediment concentration for low velocity gradient flocculation run triplicate F5 at tailgate (‘-‘indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	31.4811	31.7003	0.2192	0.8768
2	26.3132	26.7032	0.3900	1.5600
3	26.4072	26.6557	0.2485	0.9940
4	31.3336	31.3751	0.0415	0.1660
5	26.4540	26.5975	0.1435	0.5740
6	31.5061	31.5457	0.0396	0.1584

Table 483: Mass of the sediment settled in the trays for low velocity gradient flocculation run triplicate F5.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	433.30	442.20	8.90
2	759.20	822.85	63.65
3	759.50	886.45	126.95
4	2280.50	2969.55	689.05
5	3038.35	4093.90	1055.55
6	1518.50	1962.95	444.45
7	759.50	924.55	165.05
8	759.70	850.70	91.00
9	1519.20	1579.50	60.30
10	1519.05	1563.55	44.50
11	1519.90	1556.00	36.10



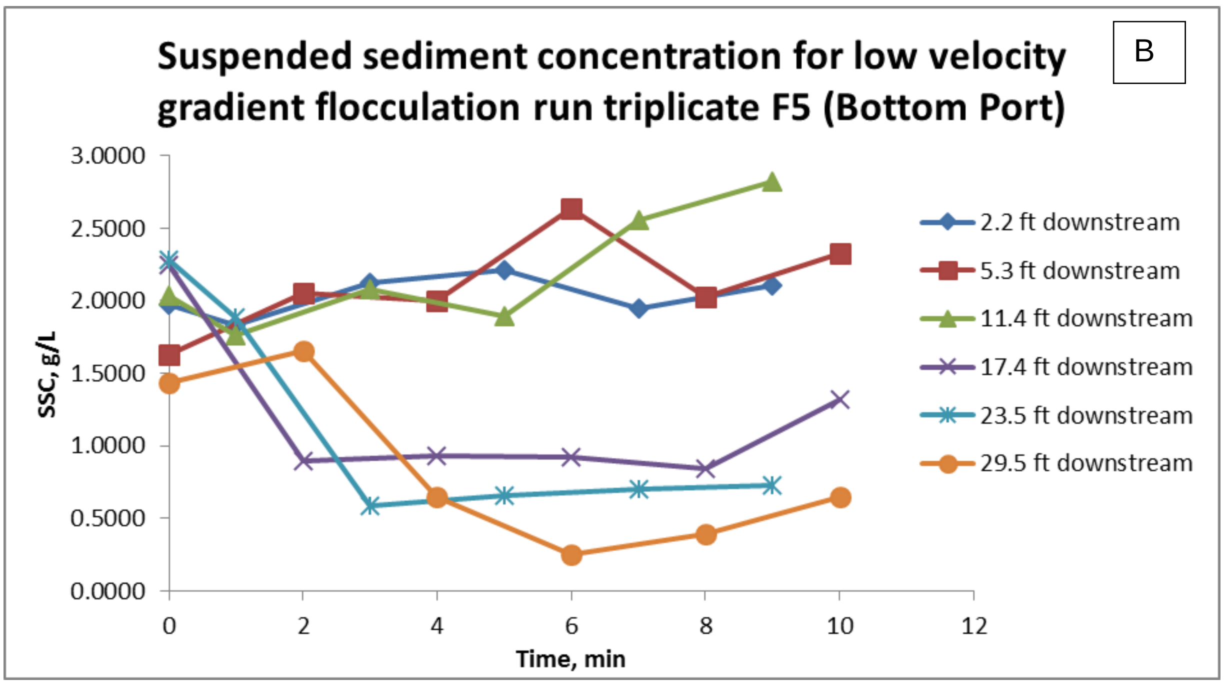


Figure 130: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

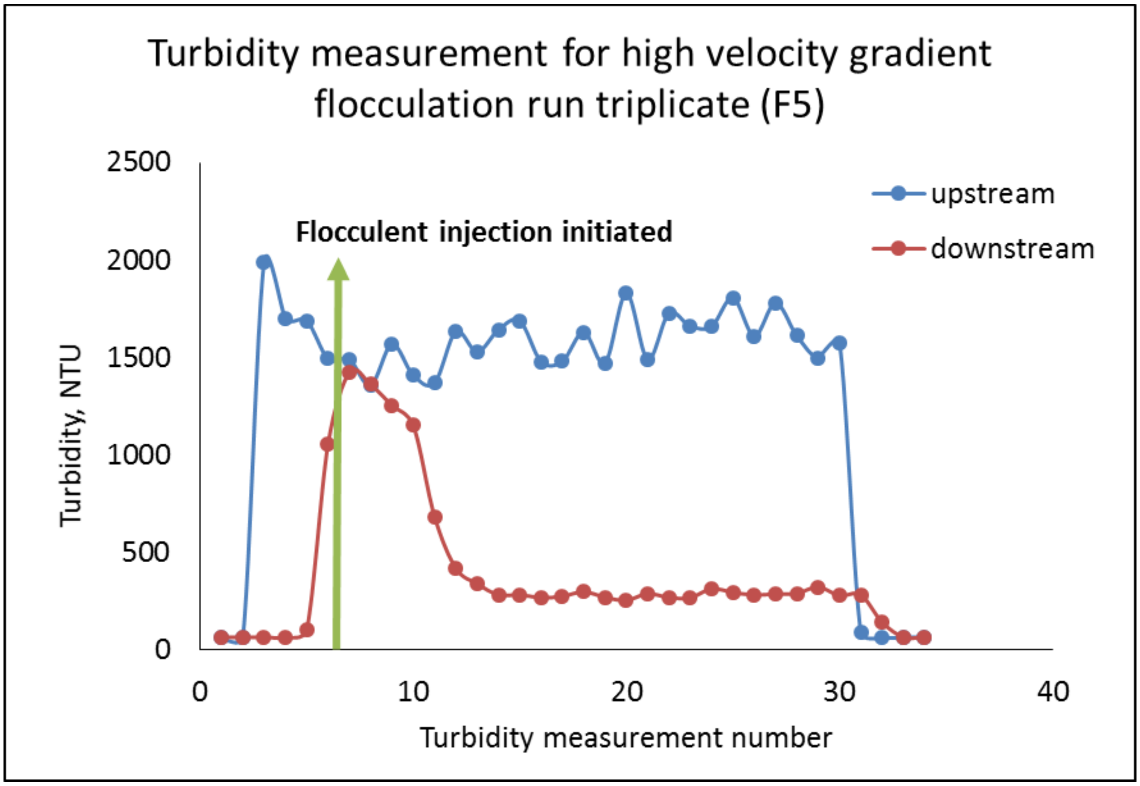


Figure 131. Upstream and downstream turbidity for low velocity gradient flocculation run triplicate F5. The turbidity measurement number indicates every 30 second time interval after which the turbidity reading was recorded by the instrument.

<u>Stephenville B High Velocity Gradient Flocculation Run Triplicate (F6)</u>

The oscillating grid speed was set at 148 rpm. Tables 484 to 491 show the data related to this run, and Figure 132 shows the graph of the sediment concentration. Figure 133 shows the graph of the upstream and downstream turbidity. Figure 134 below summarizes the trapping efficiencies for the Stephenville B soil and Table 492 shows the values of the stickiness coefficient obtained.

Table 484. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 1('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 1	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3299	31.3940	26.8086	31.8812	0.4787	0.4872	1.9148	1.9488
2	26.5437	26.2870	27.0122	26.7999	0.4685	0.5129	1.8740	2.0516
3	31.3862	26.3366	31.9140	26.8940	0.5278	0.5574	2.1112	2.2296
4	26.5442	26.4011	27.0304	26.9209	0.4862	0.5198	1.9448	2.0792
5	31.5105	31.4232	32.0128	31.9207	0.5023	0.4975	2.0092	1.9900
6	26.5245	31.5412	27.0023	32.0903	0.4778	0.5491	1.9112	2.1964

Table 485. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 2('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 2	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3756	26.3908	26.8976	26.9370	0.5220	0.5462	2.0880	2.1848
2	31.4037	26.4808	31.9329	27.0223	0.5292	0.5415	2.1168	2.1660
3	26.3010	26.5205	26.8185	27.0164	0.5175	0.4959	2.0700	1.9836
4	26.2765	26.4807	26.8425	27.0422	0.5660	0.5615	2.2640	2.2460
5	26.3405	31.3245	26.9055	31.6914	0.5650	0.3669	2.2600	1.4676
6	31.3812	31.5282	31.9283	32.0746	0.5471	0.5464	2.1884	2.1856

Table 486. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 3('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 3	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3497	26.2626	26.9215	26.8393	0.5718	0.5767	2.2872	2.3068
2	31.3831	26.2730	31.9315	26.8369	0.5484	0.5639	2.1936	2.2556
3	26.3705	31.4705	26.7722	32.0084	0.4017	0.5379	1.6068	2.1516
4	31.4546	31.4477	31.8695	31.9867	0.4149	0.5390	1.6596	2.1560
5	31.5857	31.4475	31.9780	31.9260	0.3923	0.4785	1.5692	1.9140
6	26.4257	26.4123	26.8537	26.9947	0.4280	0.5824	1.7120	2.3296

Table 487. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 4('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 4	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	26.3014	31.6051	26.8501	31.9752	0.5487	0.3701	2.1948	1.4804
2	31.4792	31.6000	31.8503	32.0175	0.3711	0.4175	1.4844	1.6700
3	26.4802	26.3966	26.7075	26.6804	0.2273	0.2838	0.9092	1.1352
4	31.4459	26.4963	31.6737	26.8018	0.2278	0.3055	0.9112	1.2220
5	31.4242	26.2282	31.6574	26.5730	0.2332	0.3448	0.9328	1.3792
6	31.1467	26.2690	31.3712	26.5985	0.2245	0.3295	0.8980	1.3180

Table 488. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 5('-'indicates No data available).

Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 5	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2924	26.2518	31.7506	26.8001	0.4582	0.5483	1.8328	2.1932
2	26.2722	31.4568	26.7954	31.9950	0.5232	0.5382	2.0928	2.1528
3	26.3481	31.3975	26.4667	31.6997	0.1186	0.3022	0.4744	1.2088
4	31.5040	26.2668	31.6787	26.4970	0.1747	0.2302	0.6988	0.9208
5	31.2308	26.2922	31.4198	26.5750	0.1890	0.2828	0.7560	1.1312
6	31.3675	26.3073	31.5600	26.5295	0.1925	0.2222	0.7700	0.8888

Table 489. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at Station 6('-'indicates No data available).

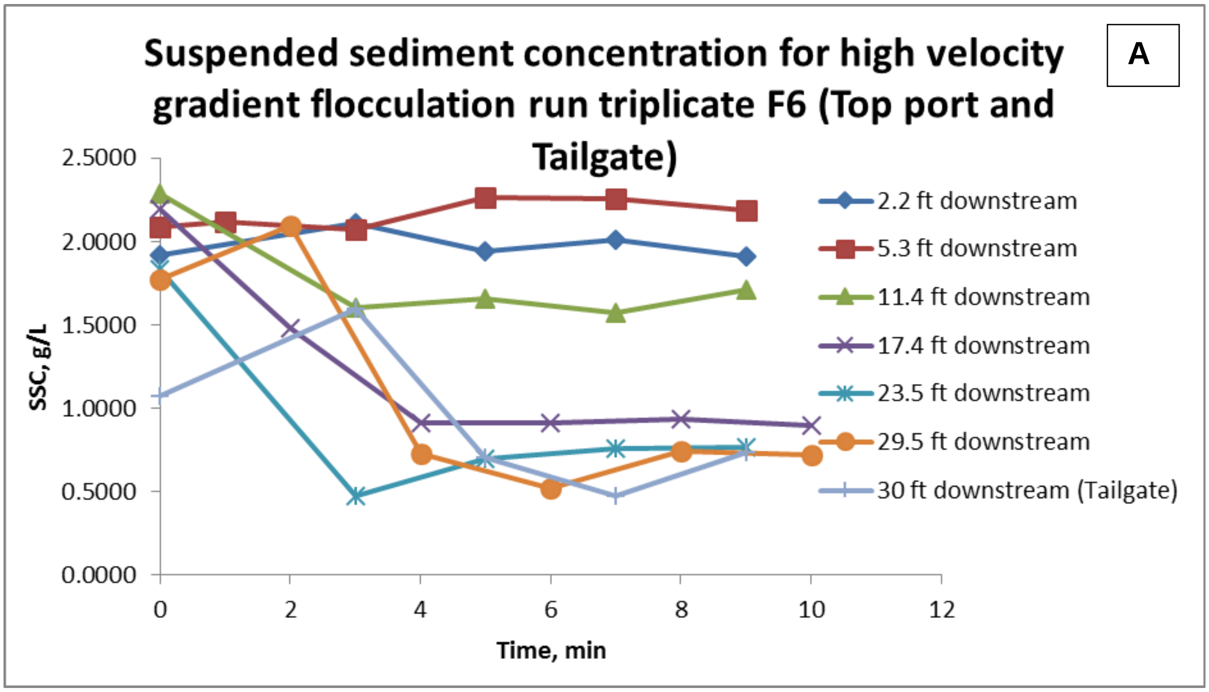
Sample	Weight without sediment (g)	Weight without sediment (g)	Weight with sediment (g)	Weight with sediment (g)	Sediment Weight (g)	Sediment Weight (g)	Sediment concentration (g/L)	Sediment concentration (g/L)
Station 6	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
1	31.2681	26.4140	31.7120	26.9128	0.4439	0.4988	1.7756	1.9952
2	26.3818	31.5323	26.9053	32.0556	0.5235	0.5233	2.0940	2.0932
3	26.3438	26.2788	26.5250	26.5320	0.1812	0.2532	0.7248	1.0128
4	26.3245	26.3950	26.4538	26.6179	0.1293	0.2229	0.5172	0.8916
5	31.3543	31.4529	31.5399	31.6759	0.1856	0.2230	0.7424	0.8920
6	31.4439	31.4024	31.6239	31.6023	0.1800	0.1999	0.7200	0.7996

Table 490. Suspended sediment concentration for high velocity gradient flocculation run triplicate F6 at tailgate('-'indicates No data available).

Tailgate	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)	Sediment concentration (g/L)
1	26.3229	26.5917	0.2688	1.0752
2	26.4279	26.8942	0.4663	1.8652
3	26.4249	26.8245	0.3996	1.5984
4	26.4077	26.5837	0.1760	0.7040
5	26.5255	26.6434	0.1179	0.4716
6	31.4017	31.5852	0.1835	0.7340

Table 491. Mass of the sediment settled in the trays for high velocity gradient flocculation run triplicate F6.

Tray no	Weight without sediment (g)	Weight with sediment (g)	Sediment weight (g)
1	70.05	78.60	8.55
2	74.60	148.40	73.80
3	72.30	235.05	162.75
4	145.60	731.10	585.50
5	217.10	872.90	655.80
6	210.45	656.40	445.95
7	139.30	423.85	284.55
8	78.60	245.45	166.85
9	68.70	173.90	105.20
10	831.60	904.35	72.75
11	830.35	889.70	59.35



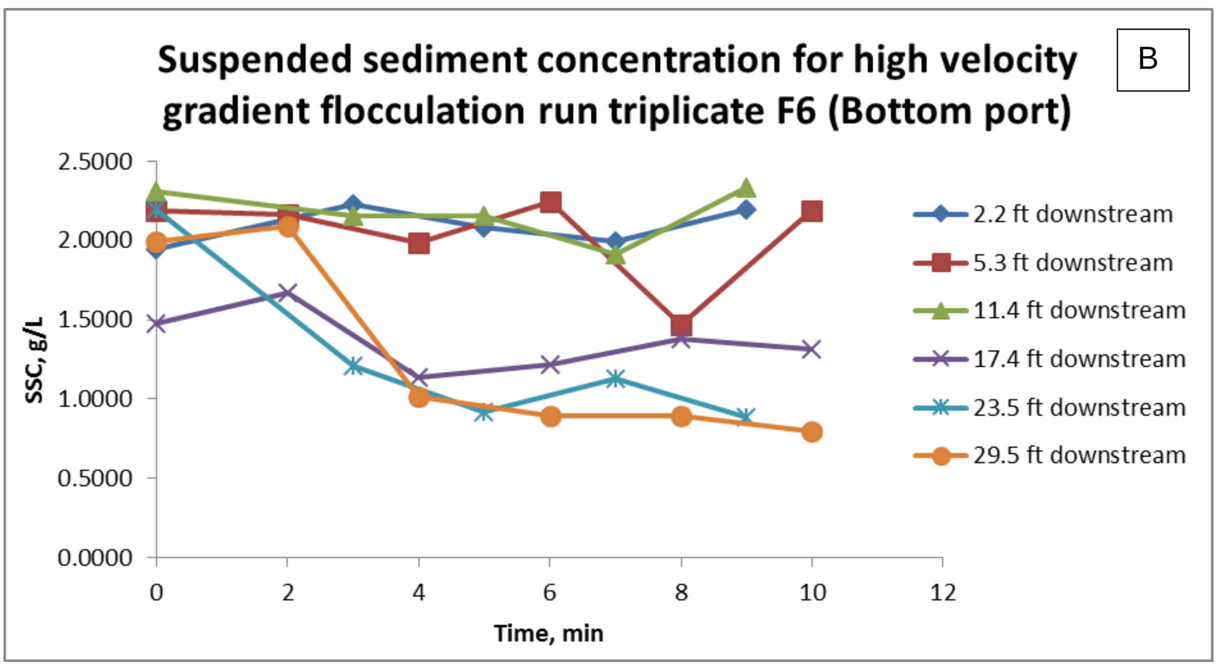


Figure 132: Graph of the suspended sediment concentration (SSC) in g/L in top port and tailgate (A) and bottom port (B) from station 1 to station 6. Sample 1 was collected at all the stations at time 0:00, the following 5 samples were collected at 1 minute interval from odd numbered and even numbered stations alternately

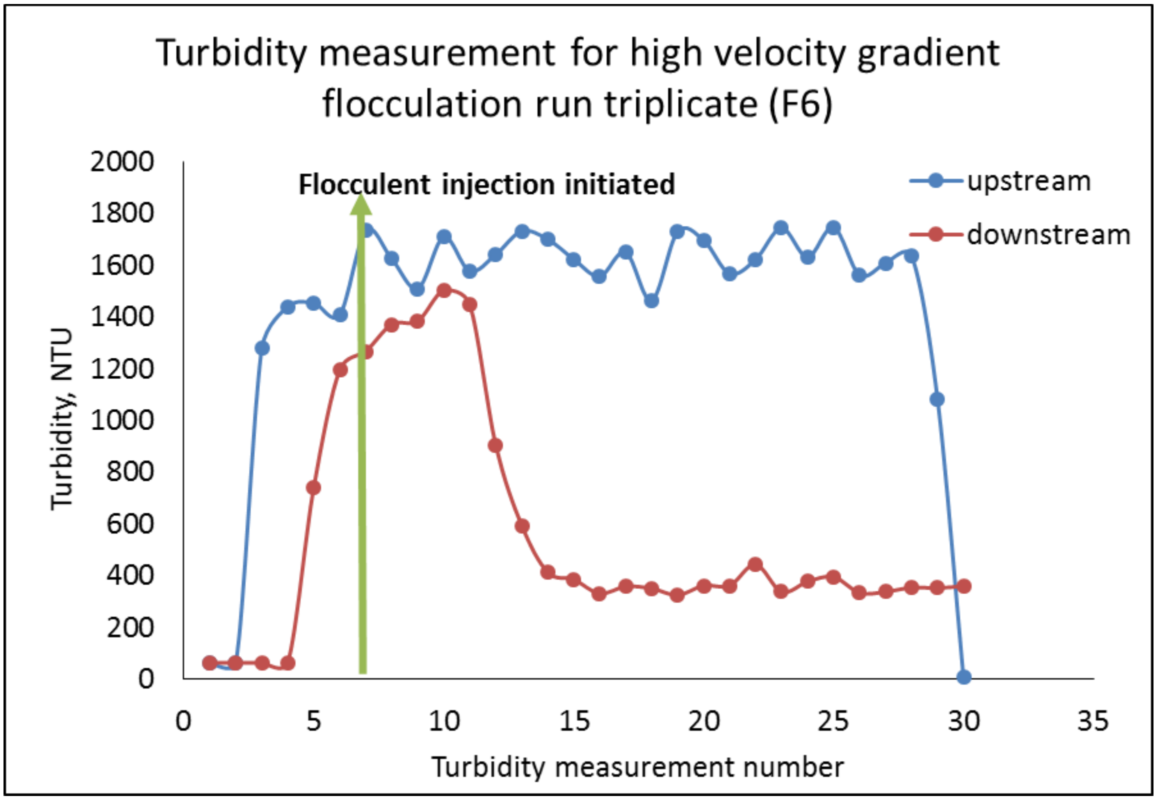


Figure 133: Graph of upstream and downstream turbidity measured for the high velocity gradient flocculation run triplicate F6.

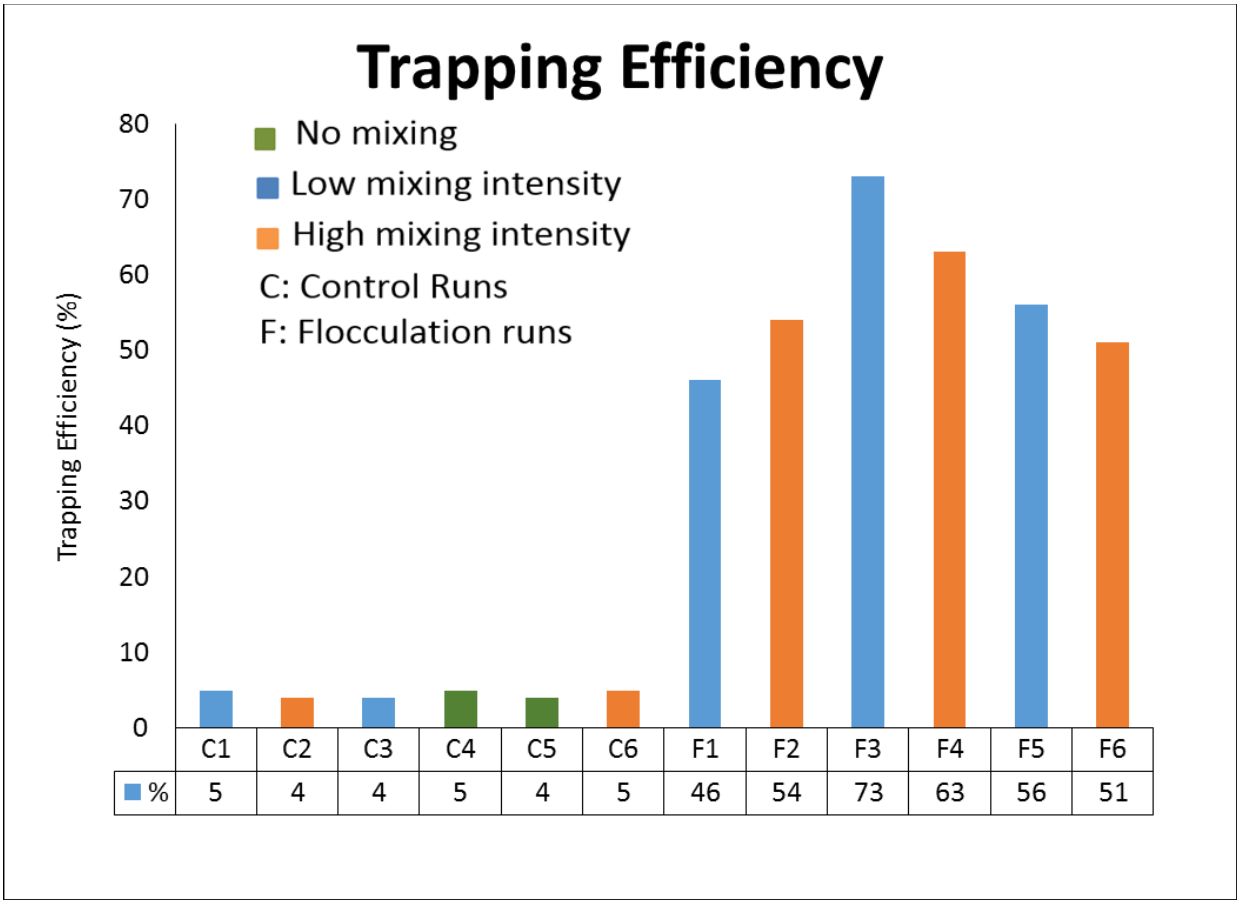


Figure 134.Trapping efficiencies for Stephenville B soil.

Table 492: Values of the stickiness coefficient α for the Pacolet soil (F: Flocculation run; Number: Experiment run number)

Low Velocity Gradient Run	High Velocity Gradient Run
F1: α= 1.35	F2: α=1.35
F3 (duplicate): α= 1.5	F4 (duplicate): α= 1.4
F5 (triplicate): α=1.4	F6 (triplicate): α=1.25

Results: Quantification of turbidity constants for five Oklahoma soils

The following section describes the results obtained for determining the relationship between turbidity and suspended sediments concentrations for five soils: Kamie B, Norge B, Stephenville B, Port A and Port B. The turbidity constants are presented for individual particle classes that is sand, silt and clay calculated with both linear and the power model are presented.

Kamie B:

Figure 135 to 137 show the primary coefficients obtained for individual particle classes i.e.: sand, silt and clay for Kamie B soil. The turbidity constants and coefficients for each primary particles of each soil are listed in Table 493.

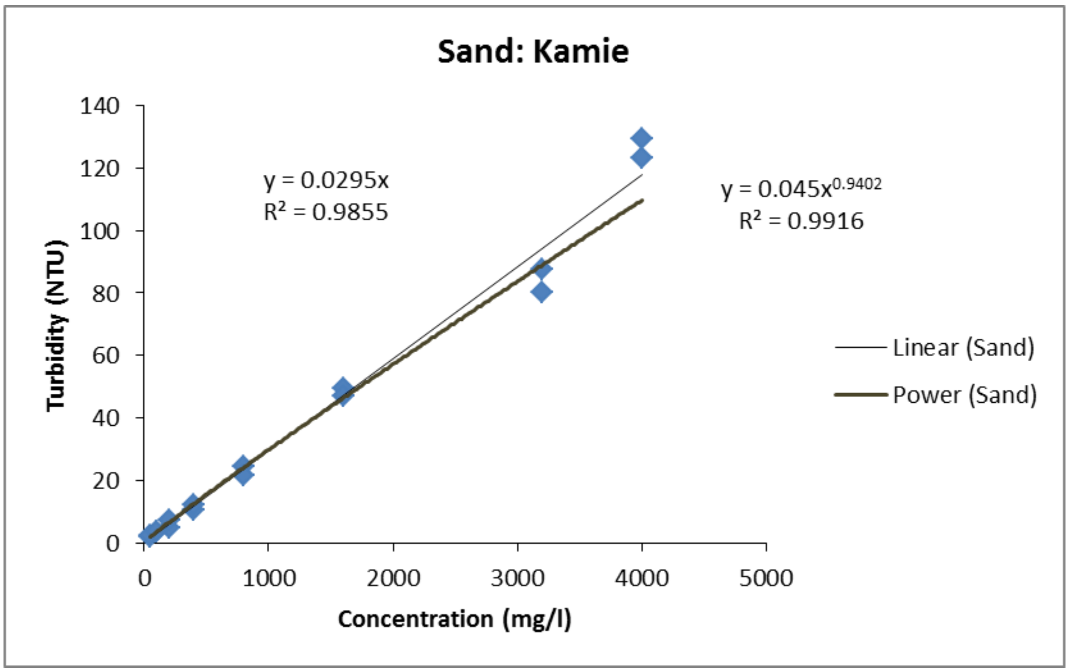


Figure 135: Plot for turbidity vs. concentration of Kamie sand with linear and non-linear power function regression lines to determine turbidity constants.

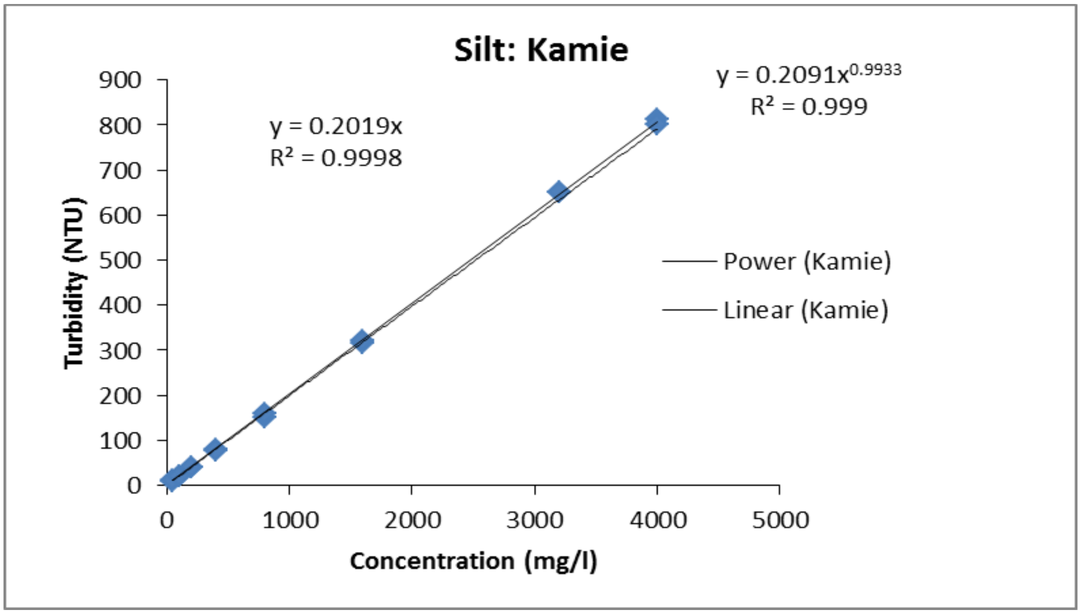


Figure 136 : Plot for turbidity vs. concentration of Kamie silt with linear and non-linear power function regression lines to determine turbidity constants.

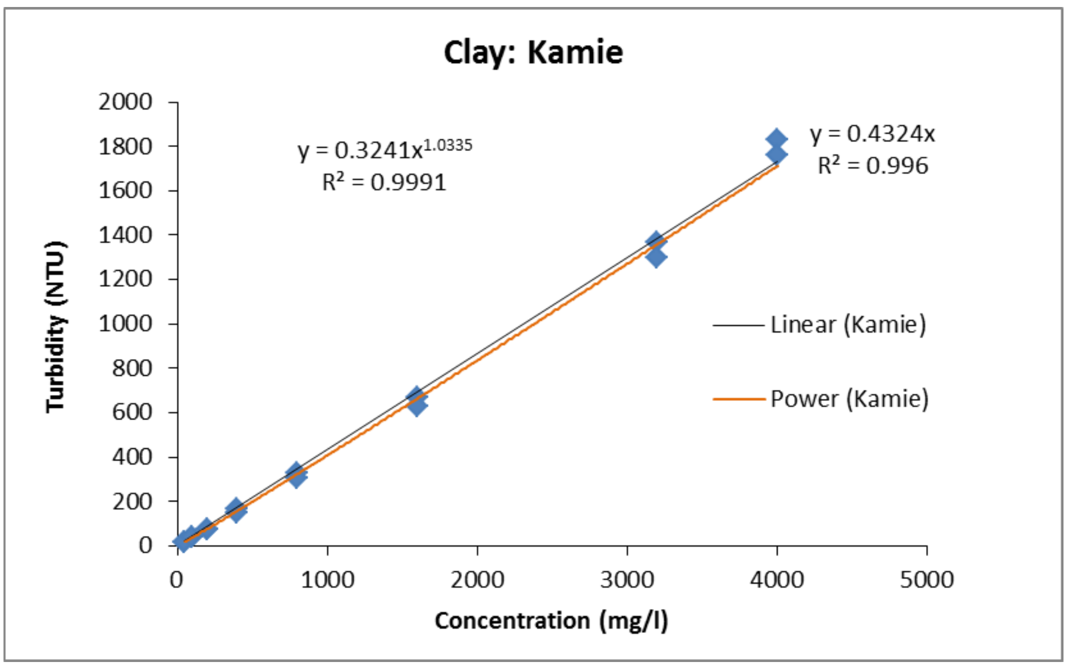


Figure 137: Plot for turbidity vs. concentration of Kamie clay with linear and non-linear power function regression lines to determine turbidity constants.

Norge B:

Figure 138 to 140 show the primary coefficients obtained for individual particle classes i.e.: sand, silt and clay for Norge B soil. The turbidity constants and coefficients for each primary particles of each soil are listed in Table 493

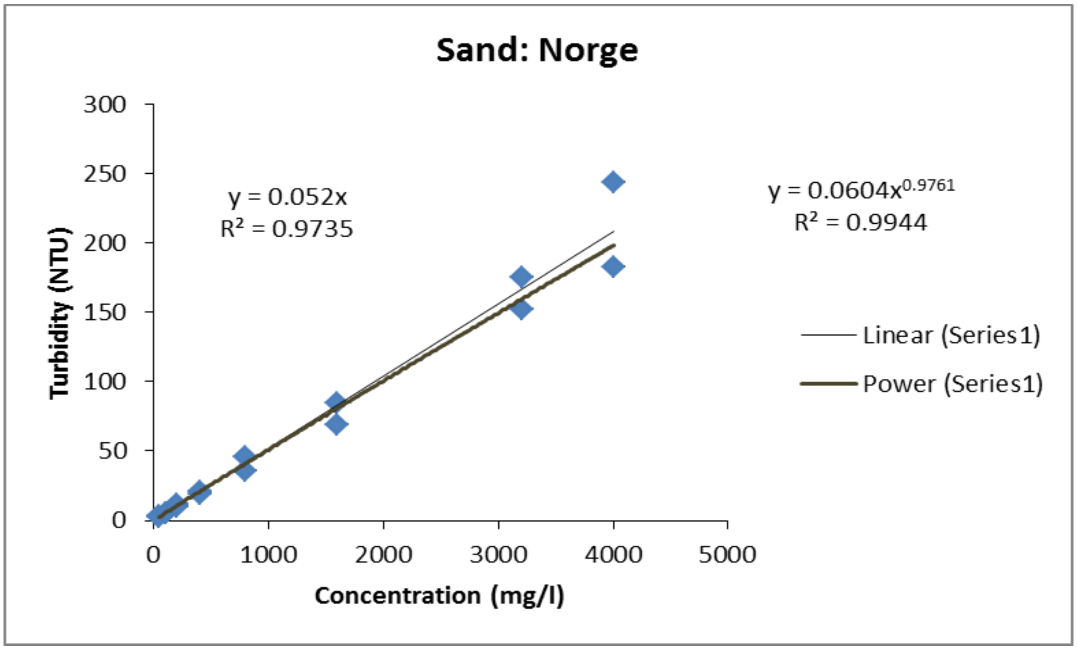


Figure 138: Plot for turbidity vs. concentration of Norge clay with linear and non-linear power function regression lines to determine turbidity constants.

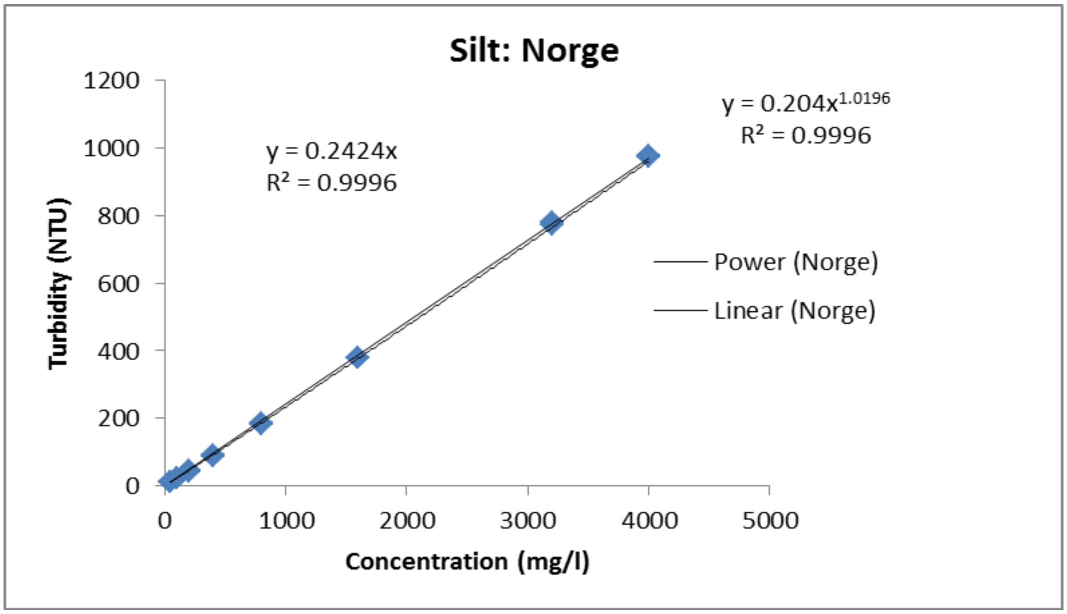


Figure 139: Plot for turbidity vs. concentration of Norge silt with linear and non-linear power function regression lines to determine turbidity constants.

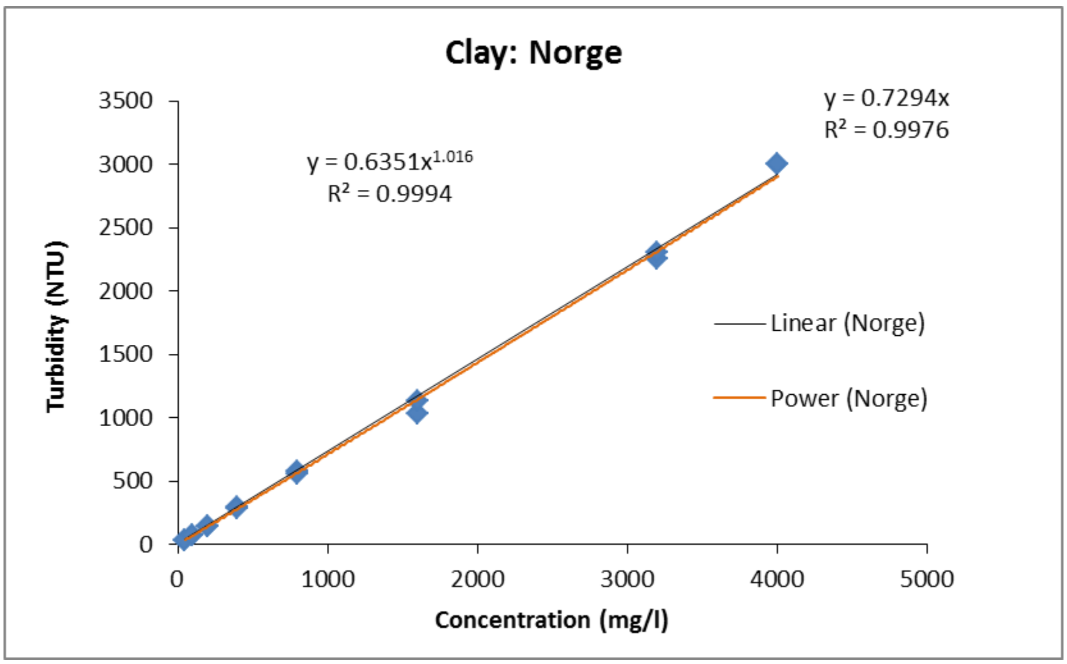


Figure 140: Plot for turbidity vs. concentration of Norge clay with linear and non-linear power function regression lines to determine turbidity constants.

Stephenville B

Figure 141 to 143 show the primary coefficients obtained for individual particle classes i.e.: sand, silt and clay for Kamie B soil. The turbidity constants and coefficients for each primary particles of each soil are listed in Table 493

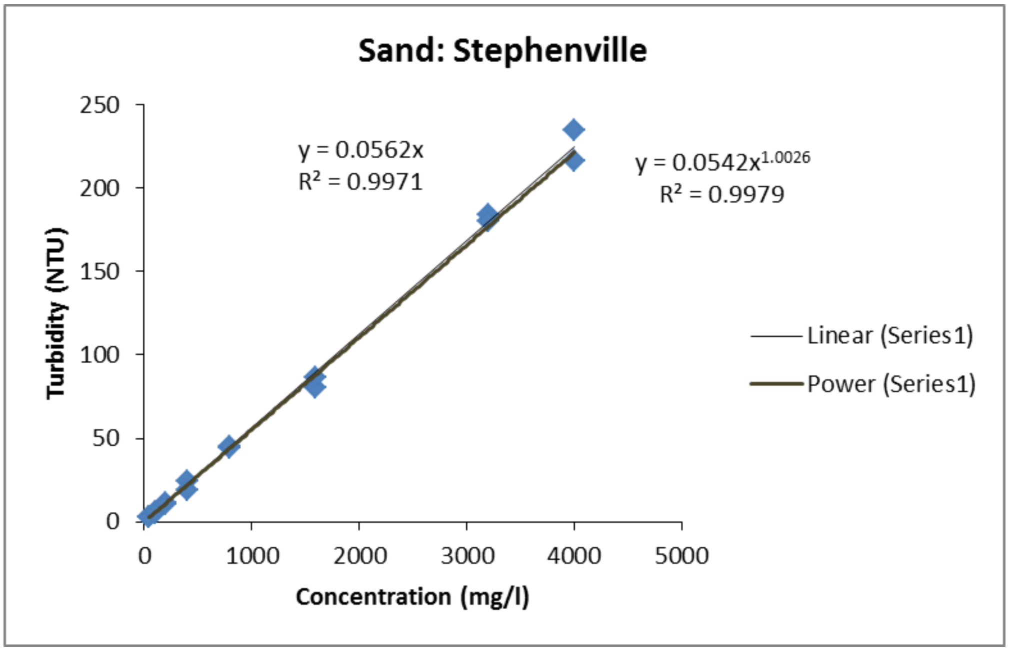


Figure 141: Plot for turbidity vs. concentration of Stephenville sand with linear and non-linear power function regression lines to determine turbidity constants.

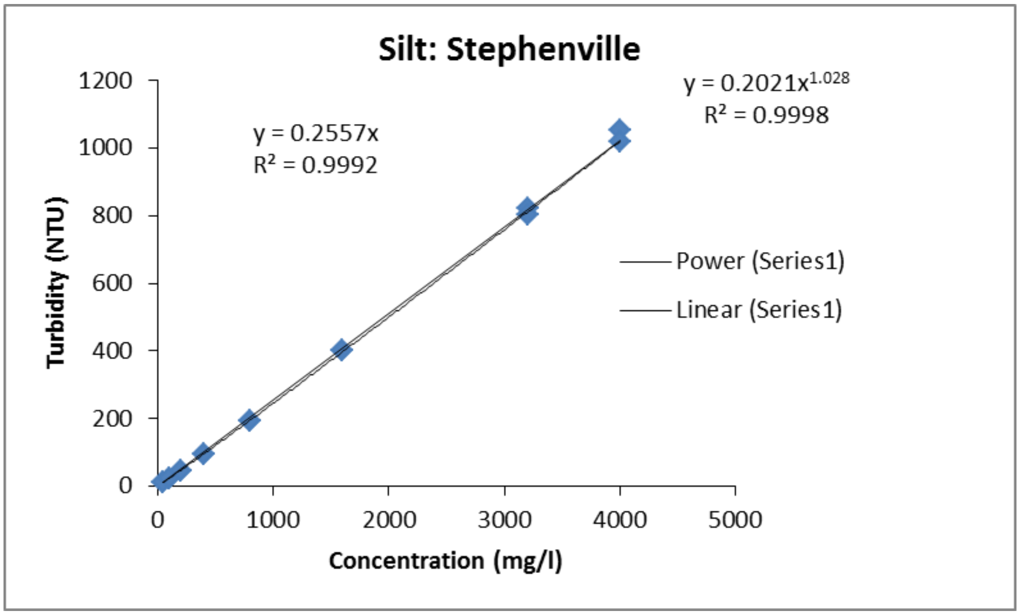


Figure 142: Plot for turbidity vs. concentration of Stephenville silt with linear and non-linear power function regression lines to determine turbidity constants.

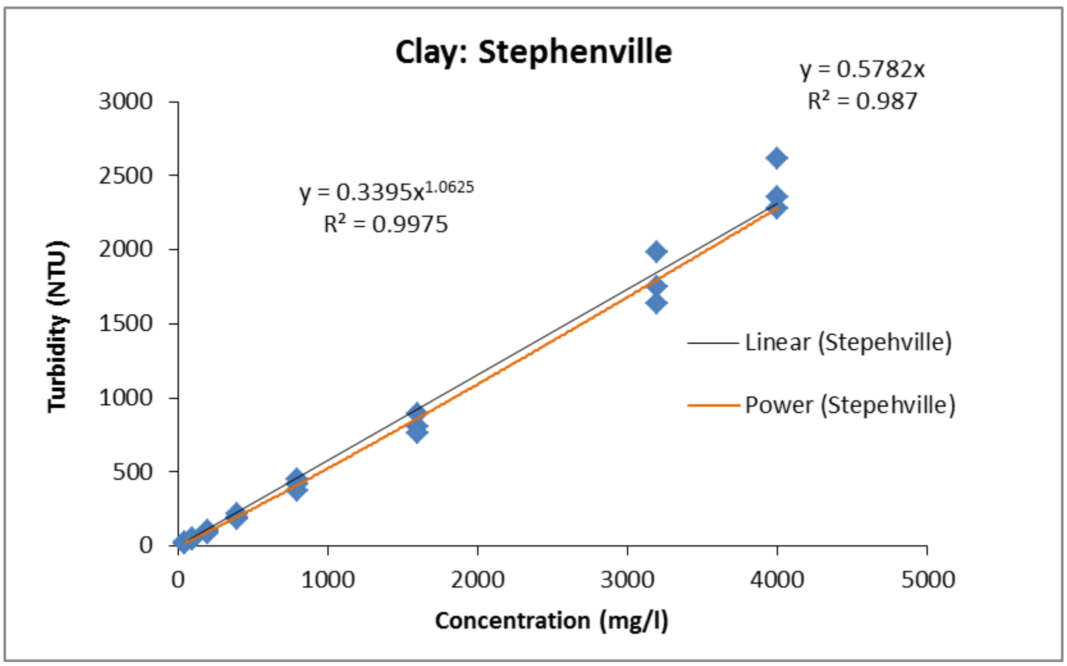


Figure 143: Plot for turbidity vs. concentration of Stephenville clay with linear and non-linear power function regression lines to determine turbidity constants.

<u>Port A</u>

Figure 144 to 146 show the primary coefficients obtained for individual particle classes i.e.: sand, silt and clay for Kamie B soil. The turbidity constants and coefficients for each primary particles of each soil are listed in Table 1

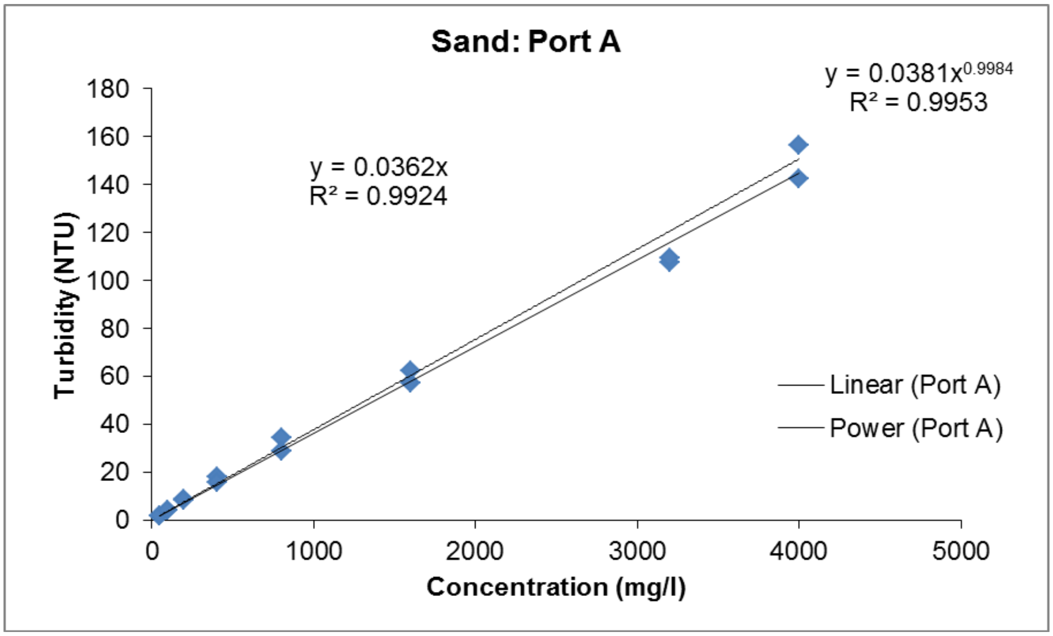


Figure 144: Plot for turbidity vs. concentration of Port A Sand with linear and non-linear power function regression lines to determine turbidity constants.

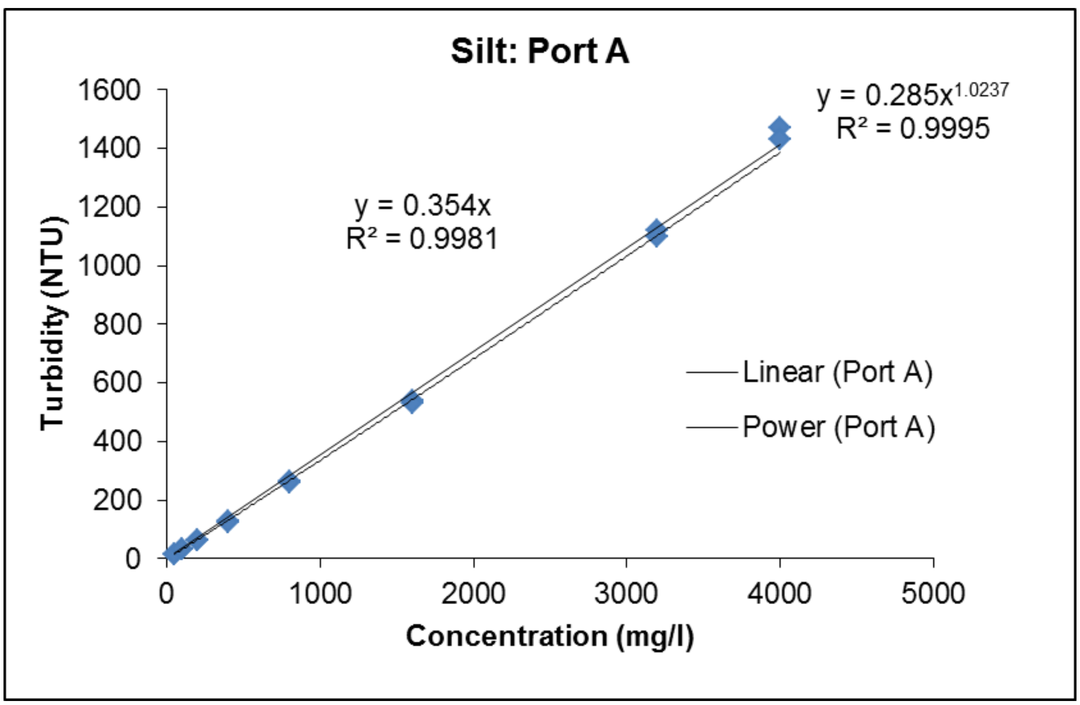


Figure 145 : Plot for turbidity vs. concentration of Port A silt with linear and non-linear power function regression lines to determine turbidity constants.

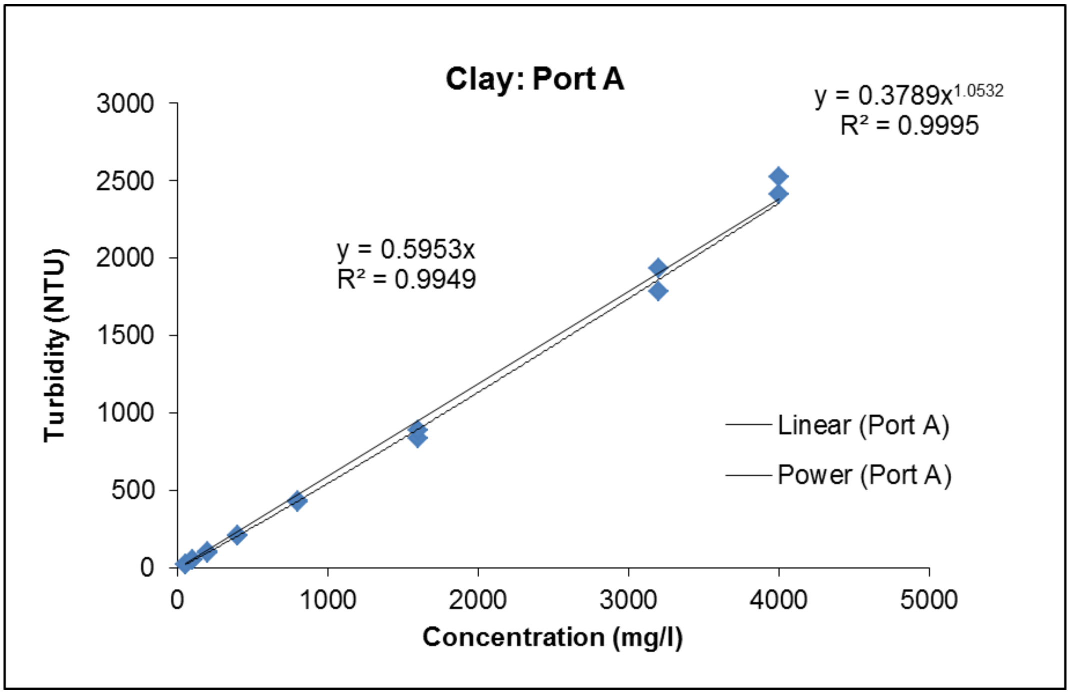


Figure 146: Plot for turbidity vs. concentration of Port A clay with linear and non-linear power function regression lines to determine turbidity constants.

Port B:

Figure 147 to 149 show the primary coefficients obtained for individual particle classes i.e.: sand, silt and clay for Kamie B soil. The turbidity constants and coefficients for each primary particles of each soil are listed in Table 493

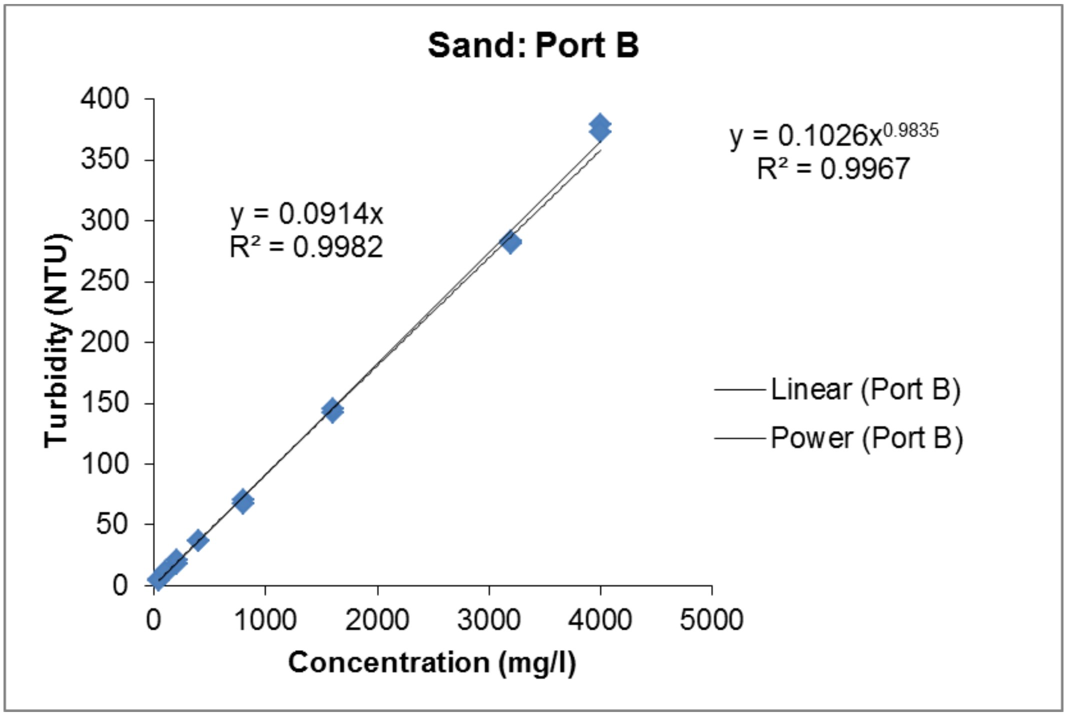


Figure 147: Plot for turbidity vs. concentration of Port B Sand with linear and non-linear power function regression lines to determine turbidity constants.

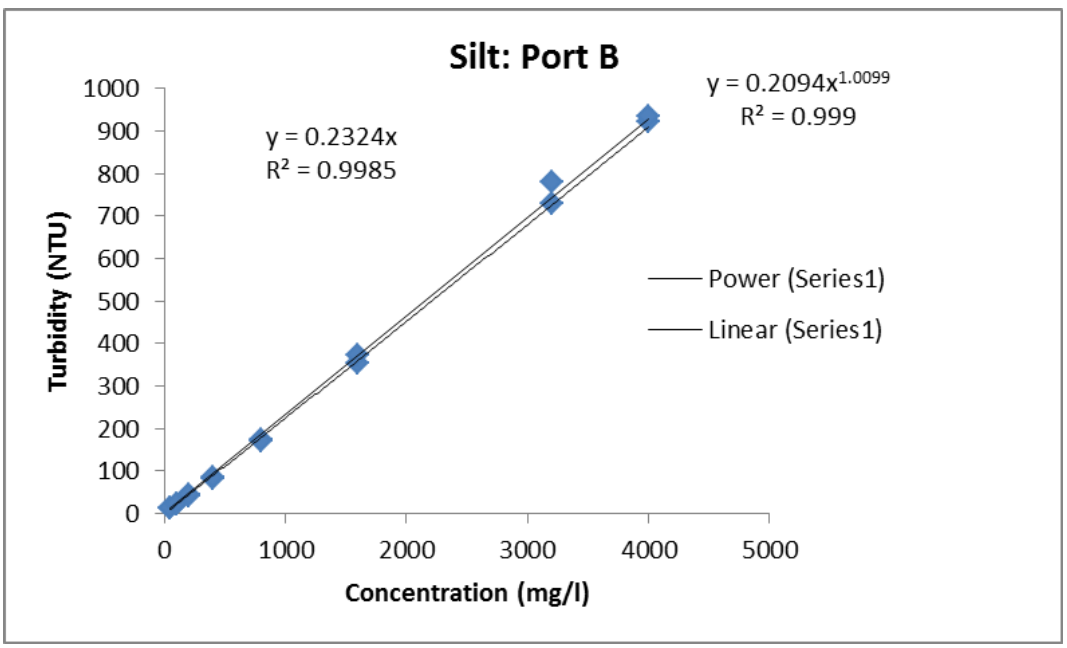


Figure 148: Plot for turbidity vs. concentration of Port B silt with linear and non-linear power function regression lines to determine turbidity constants.

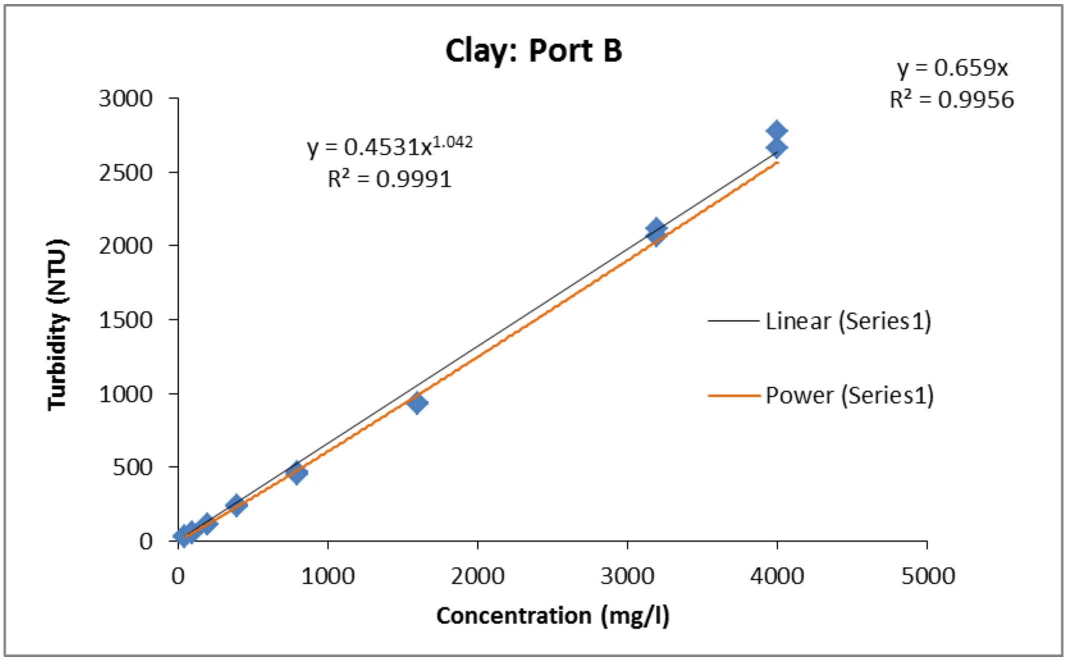


Figure 149: Plot for turbidity vs. concentration of Port B clay with linear and non-linear power function regression lines to determine turbidity constants.

Table 493: Turbidity constants for all soils as described in equation 1 and 2. The R^2 in table shows the coefficient of determination for regression analysis.

Soil Type	Turbidity Constants														
	Linear						Power								
	Sand		Silt		Clay		Sand			Silt			Clay		
	k_{1L}	R^2	k_{2L}	R^2	k_{3L}	R^2	k_{1P}	a	R^2	k_{2P}	b	R^2	k_{3P}	c	R^2
Kamie	0.030	0.986	0.202	0.9998	0.432	0.9960	0.045	0.940	0.9916	0.209	0.993	0.9990	0.324	1.034	0.9991
Norge	0.052	0.974	0.242	0.9996	0.729	0.9976	0.060	0.976	0.9944	0.204	1.020	0.9996	0.635	1.016	0.9976
Stephville	0.056	0.997	0.256	0.9992	0.578	0.9870	0.050	1.003	0.9979	0.202	1.028	0.9998	0.340	1.063	0.9975
Port A	0.036	0.992	0.354	0.9981	0.595	0.9949	0.038	0.998	0.9953	0.285	1.024	0.9995	0.379	1.063	0.9995
Port B	0.091	0.998	0.232	0.9985	0.659	0.9956	0.103	0.984	0.9967	0.209	1.010	0.9990	0.453	1.042	0.9991

Turbidity-SSC relationship verification

The measured turbidity of random combinations of sand, silt and clay of each soil were compared with predicted turbidity using equation 1, 2 and 3. Figures 150 through 159 shows the comparison between linear model and power model. Average relative error for power model was lower than linear model. Nash-Sutcliffe efficiency (NSE) value[*Nash and Sutcliffe*, 1970] was greater in power model for all soils. The NSE parameter has been used for evaluating model predicted value vs. measured value in water quality and nutrients and watershed flow [*Green et al.*, 2007; *McCuen et al.*, 2006; *Moriasi et al.*, 2007] This indicates that the turbidity makes non-linear relationship with suspended sediment concentration. The tabulated comparison of results is shown in Table 494.

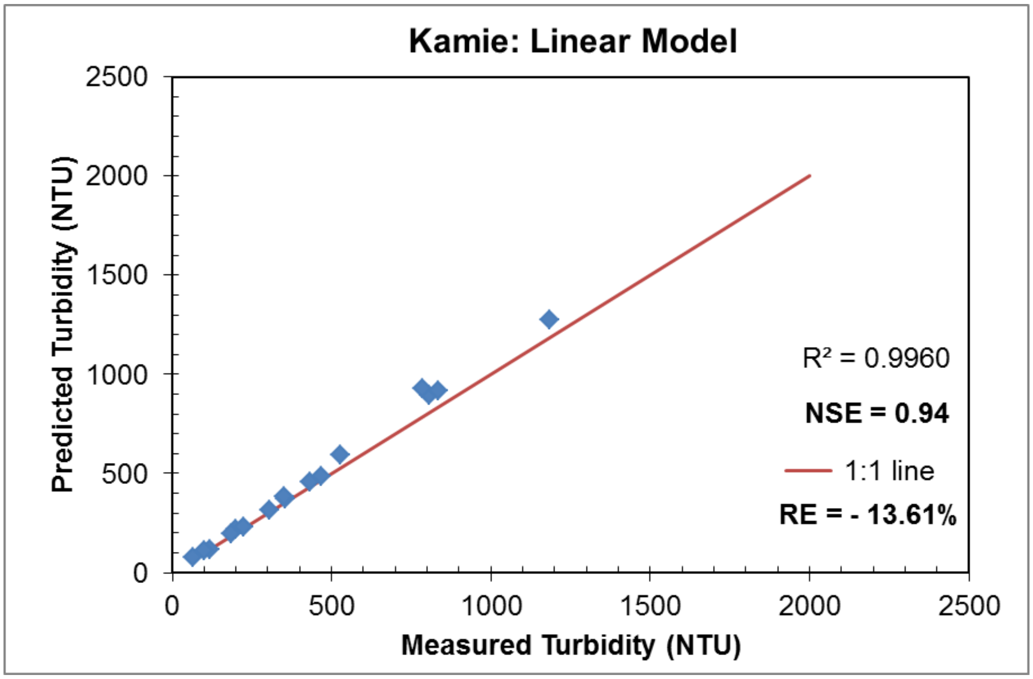


Figure 150: Predicted vs. measured turbidity for Kamie soil in linear model.

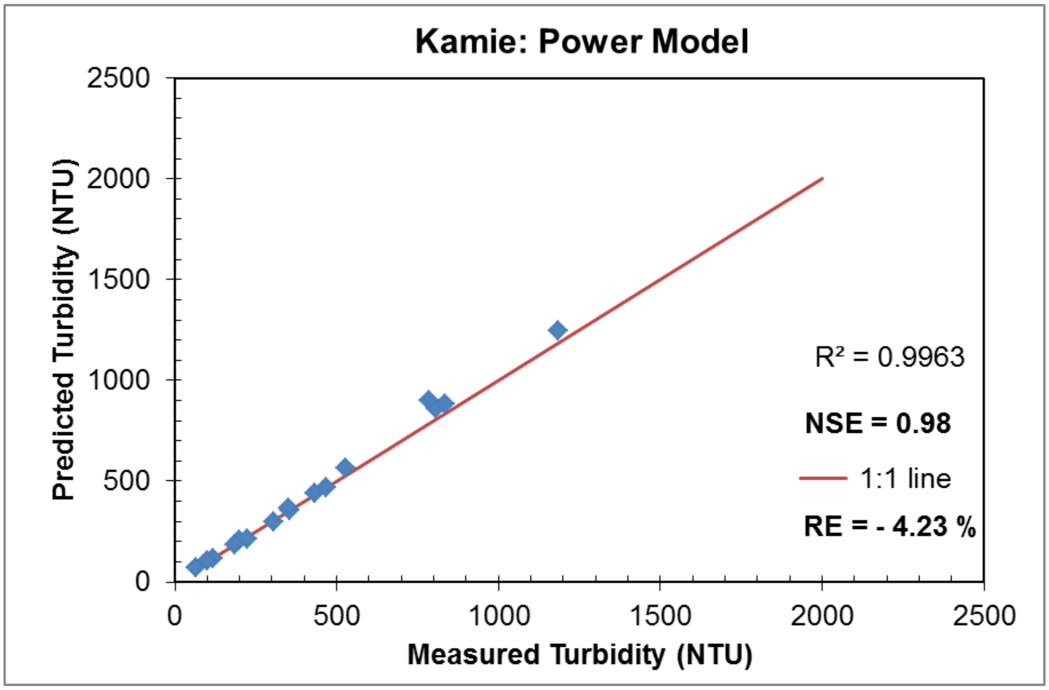


Figure 151: Predicted vs. measured turbidity for Kamie soil in power model.

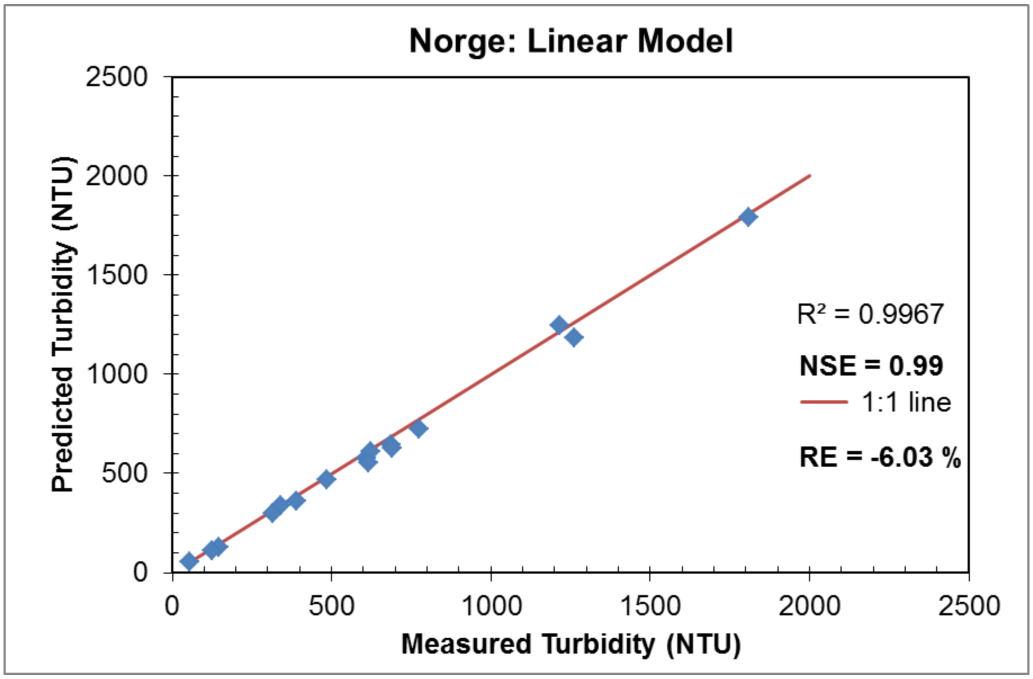


Figure 152 : Predicted vs. measured turbidity for Norge soil in linear model.

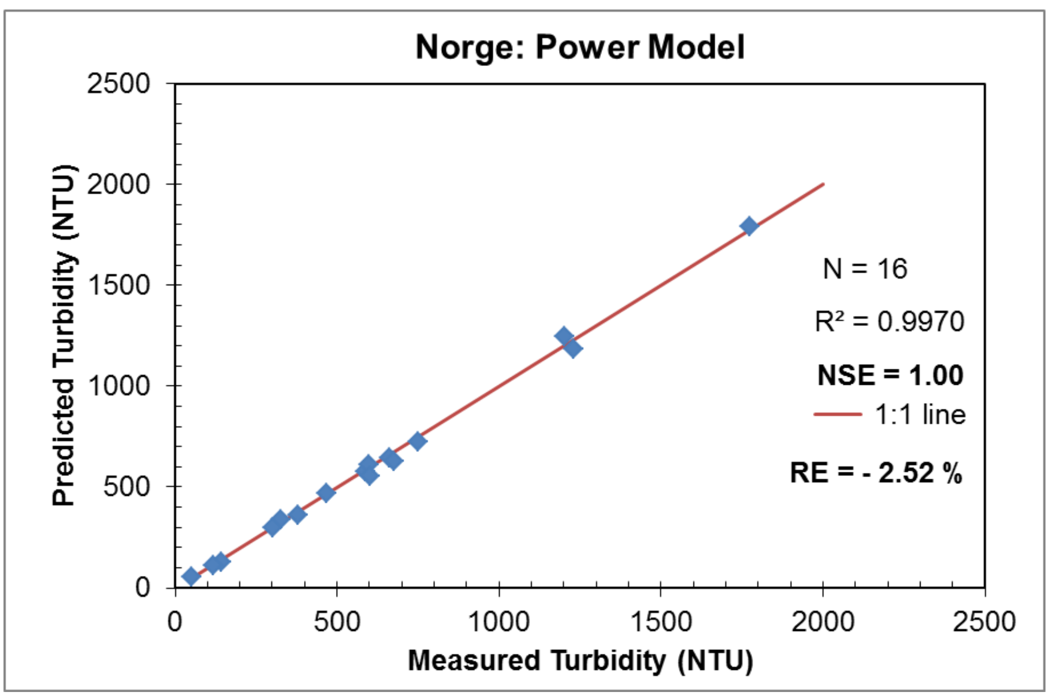


Figure 153 : Predicted vs. measured turbidity for Norge soil in power model.

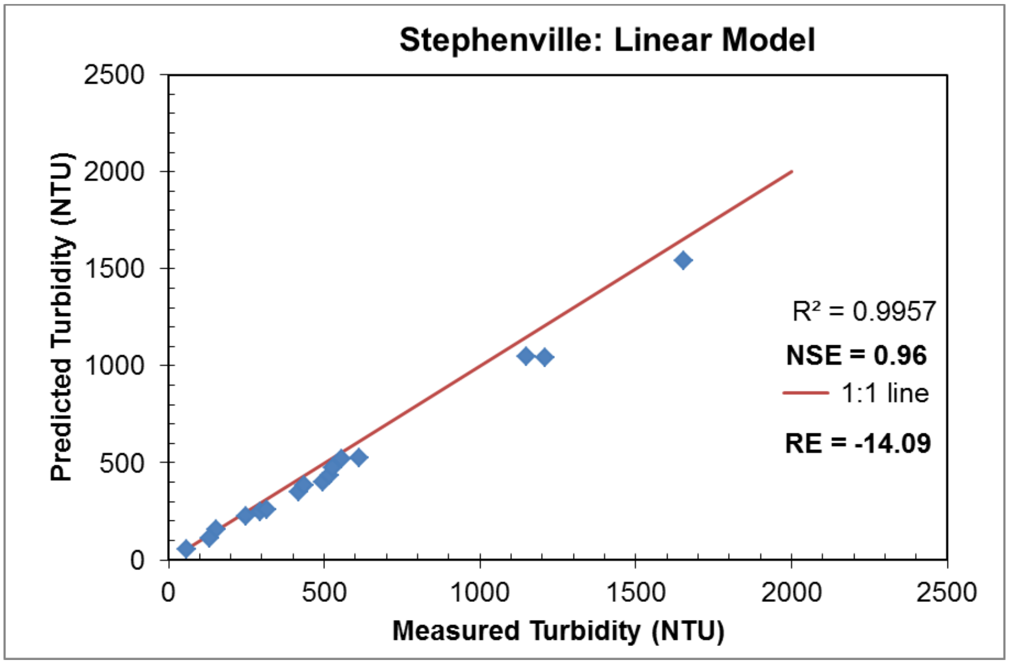


Figure 154 : Predicted vs. measured turbidity for Stephenville soil in linear model.

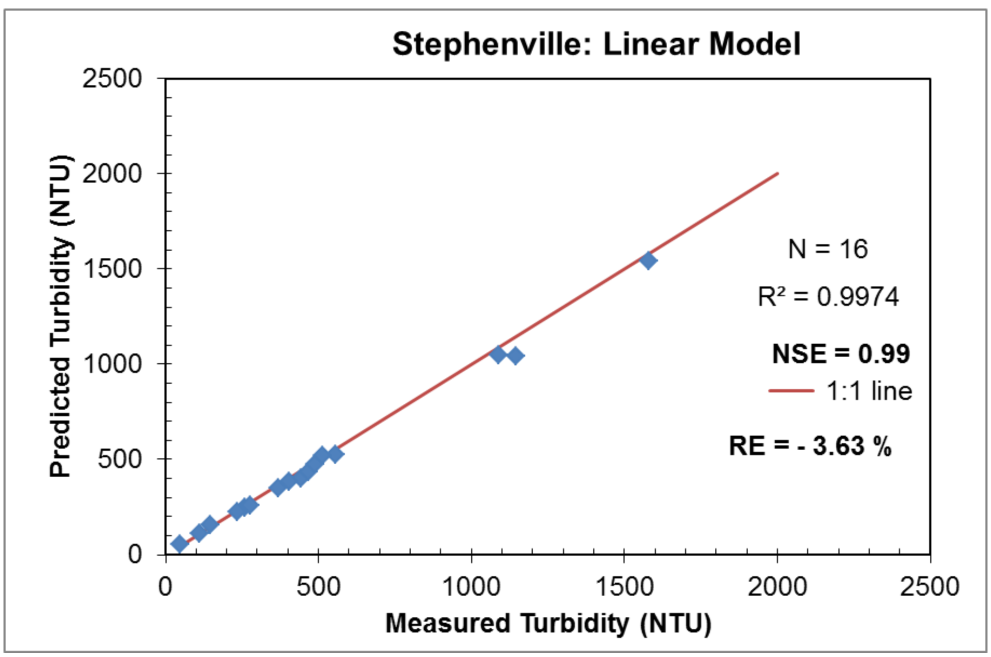


Figure 155: Predicted vs. measured turbidity for Stephenville soil in power model.

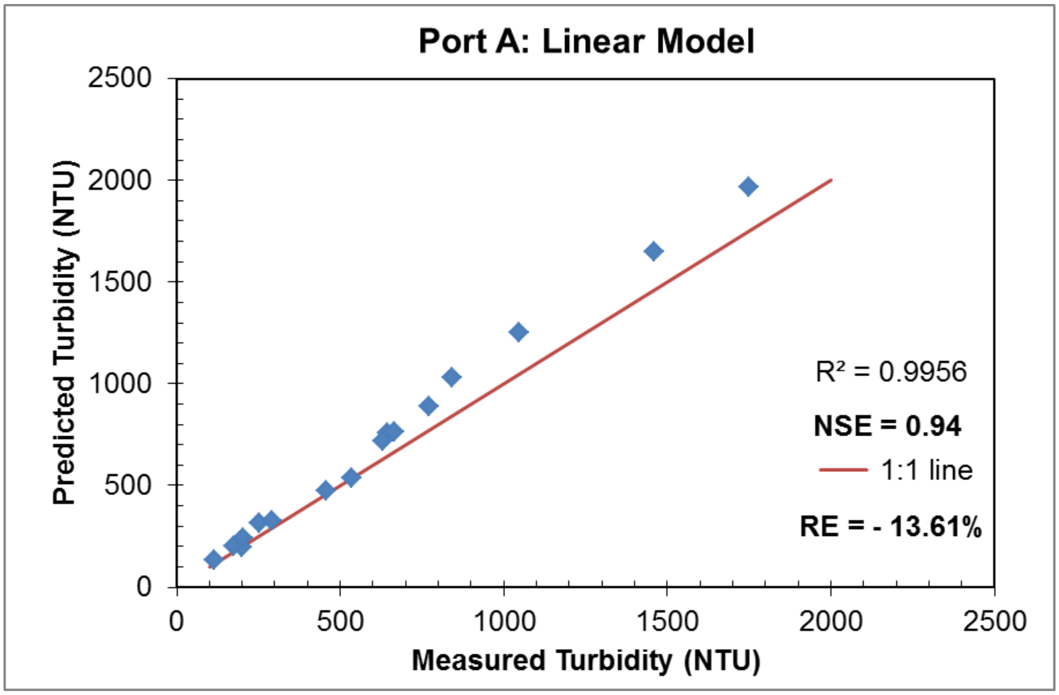


Figure 156 : Predicted vs. measured turbidity for Port A soil in linear model.

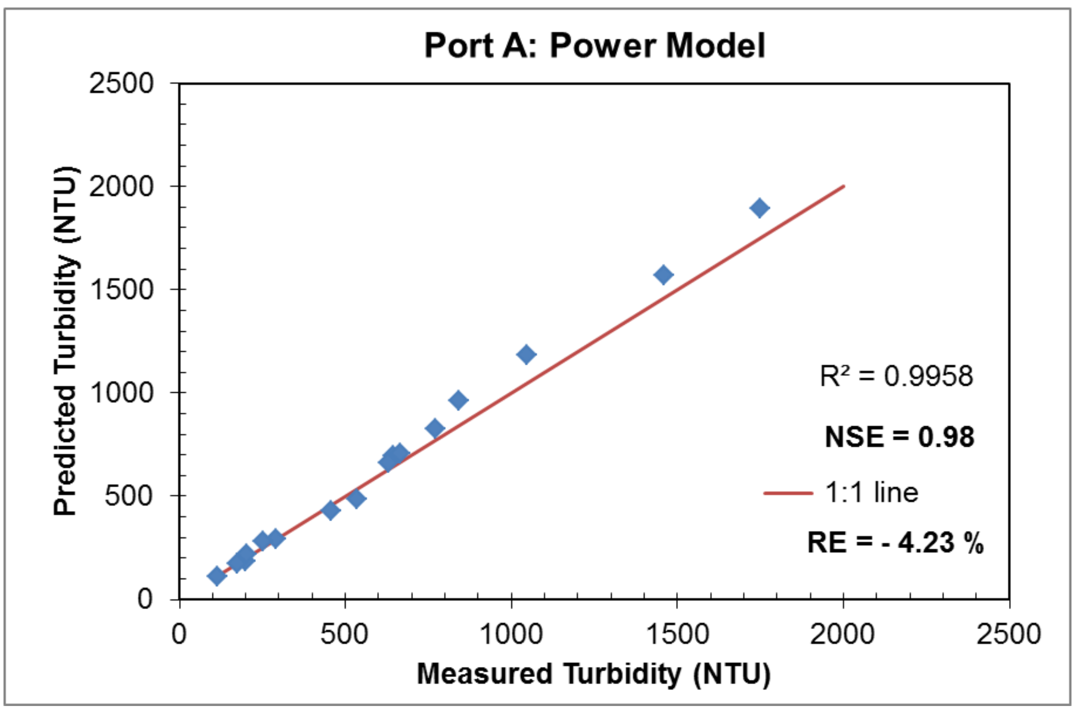


Figure 157 : Predicted vs. measured turbidity for Port A soil in power model.

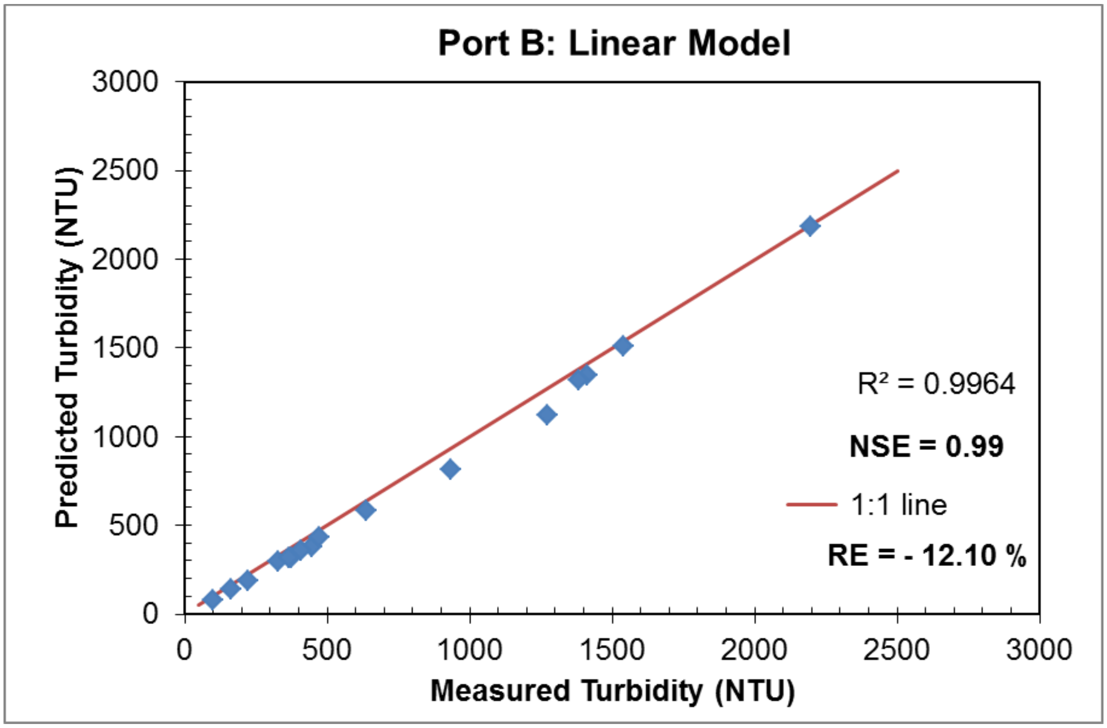


Figure 158 : Predicted vs. measured turbidity for Port B soil in linear model.

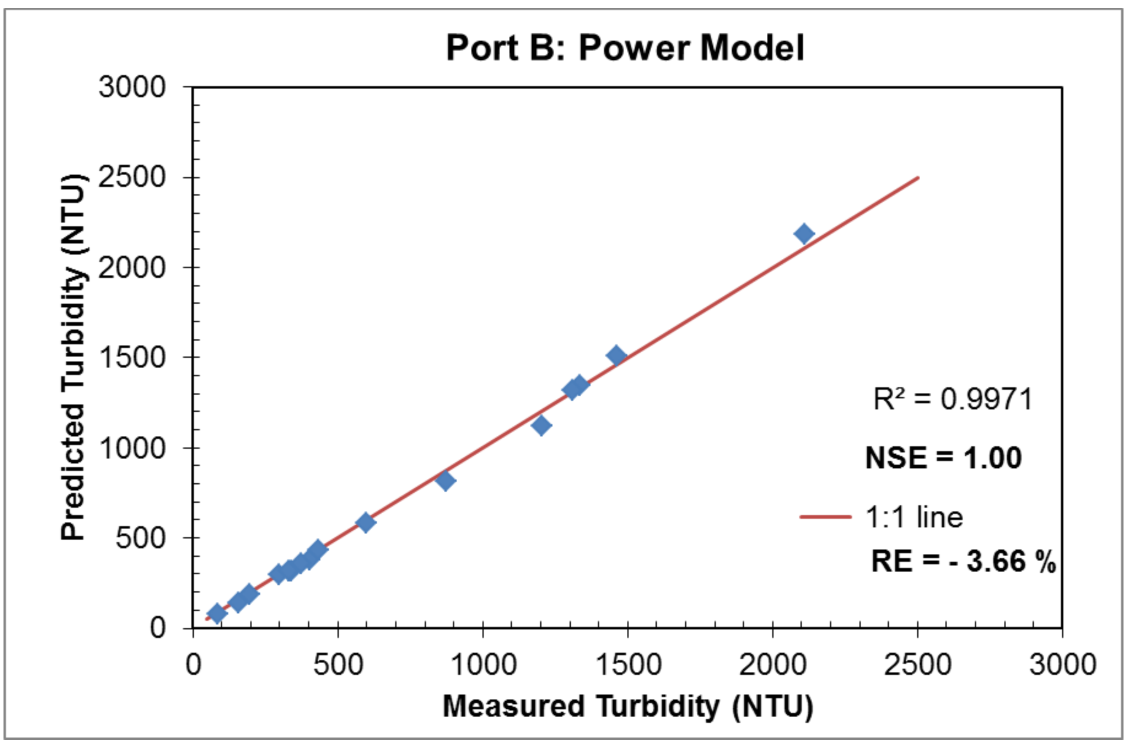


Figure 159 : Predicted vs. measured turbidity for Port A soil in power model.

Table 494 : Linear vs. power model performance comparison

Soil Type	Linear			Power		
	R^2 *	NSE**	RE (%)***	R^2	NSE	RE (%)
Kamie	0.9960	0.94	-13.6	0.9963	0.98	-4.23
Norge	0.9967	0.99	-6.03	0.9970	1.00	-2.52
Stephenville	0.9957	0.96	-14.09	0.9974	0.99	-3.63
Port A	0.9956	0.94	-13.61	0.9958	0.98	-4.23
Port B	0.9964	0.99	-12.1	0.9971	1	-3.66

* Coefficient of Determination, ** Nash-Sutcliffe Efficiency *** Relative Error

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Task 2: Investigate the validity of using laboratory jar test results to design the OSU Flocculant Injection and Mixing System for removal of sediment from construction site runoff.

Traditional jar tests were designed for the water and wastewater industry to determine the flocculant dose needed to treat the water. They are a preliminary indication of reduction in the turbidity with the help of a particular flocculant. They are important because various impacts of the physical parameters can be tested using the jar tests. This task was divided into 2 main subtasks, which are as described below:

1. To determine the impacts of the physical parameters that affect the turbidity reduction efficiency with the help of jar tests
2. Testing the properties of Hydrofloc 445 L
3. Determine the turbulence kinetic energy in the jar tests with the help geometric similitude studies

Impacts of Physical Parameters on Turbidity Reduction Efficiency

Several properties effect the flocculation and settling of clay and silt particles. Although each parameter can be tested alone, the flocculation process is affected by all of the parameters working together. The parameters that affect the flocculation process include mixing speed, flocculant concentration and sediment concentration. Each of these parameters was tested to determine the optimal and most efficient range. This information could then be applied in the flume and field studies.

Method

All tests were performed using Phipps & Bird square two-liter jars as shown in Figure 160 with mixing speed capabilities ranging from 5-300 revolutions per minute (rpm) and stirring times ranging from 1 second to 60 minutes. A Port soil was used in all of the experiments due to its large range across Oklahoma as shown in Figure 161 (SSURGO, USDA-NRCS). The soil spans 26 counties in the central part of the state.

The soil was first sieved using a 10 mesh sieve to remove the larger aggregates. To represent the settling forebay to remove the sand and larger particles, the jars were first mixed for 30 seconds at 120 rpm and allowed to settle for 66 seconds. The settling time was calculated for a 0.05 mm diameter sand grain using the Stokes equation. After 66 seconds of settling, the supernatant liquid was poured off into another jar. Once the jar was brought up to two liters, the flocculant was added and mixed for 5-30 seconds. After a settling time ranging from one minute to five minutes, a 20 ml sample was taken. The turbidity of the sample was immediately tested using a using a 2100Q Hach turbidity meter as shown in Figure 162

Figure 160. The jar tests used in the testing of the various parameters and their effect on flocculation and turbidity reduction.

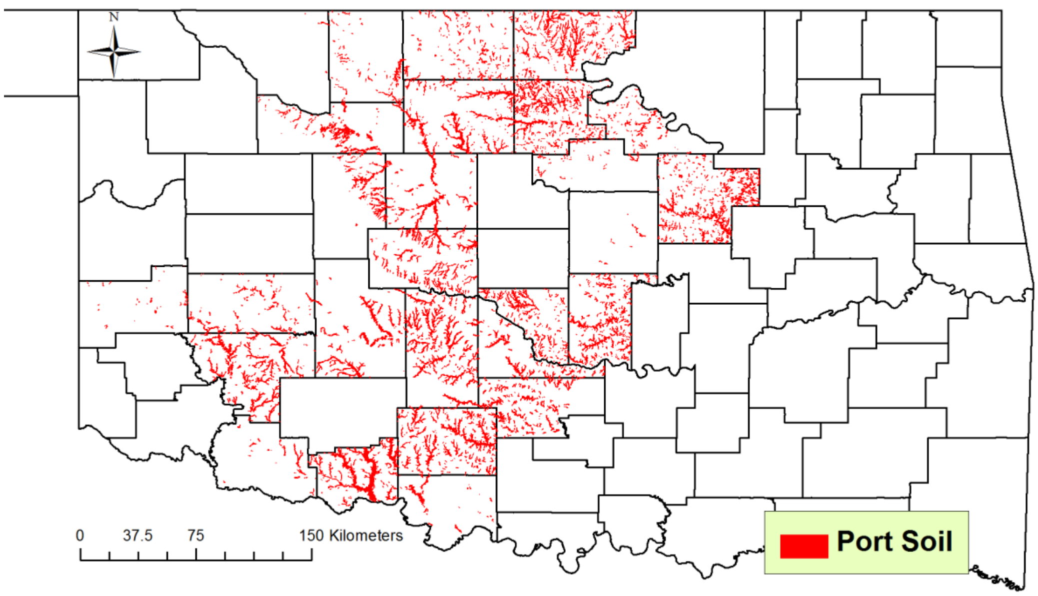


Figure 161. The location of the Port soil, which was utilized in the testing of the various flocculation parameters.

Figure 162. The 2100Q Hach turbidity meter used to test the turbidity for the jar tests.

Testing the properties of Hydrofloc 445 L

Since Hydrofloc 445L was chosen as the polymer to utilize in the jar tests and flume and field studies, we did a more in-depth analysis of the polymer. We measured the viscosity of Hydrofloc at various dilutions. This aided us in determining the dilution we would use in the flocculant holding tank. We then performed several tests to determine the effect of temperature on the polymer's viscosity and effectiveness over time.

In the field the Hydrofloc will be stored outside for extended periods of time exposed to Oklahoma's diverse temperatures. We wanted to determine the effect that these temperatures would have on the flocculant's viscosity and effectiveness over time.

Method

We diluted Hydrofloc to 1, 10 and 100 g l^{-1}. We then stored one liter of each dilution plus 100% Hydrofloc in the refrigerator at 4°C, the oven at 50°C and at room temperature at 23°C. Using a rotary viscometer, we measured the viscosity of Hydrofloc at day 0 and every 1-3 weeks for 100 days. At day 28, the flocculant was removed from the oven and refrigerator for one day to bring back to room temperature. The objective of this was to determine if there was any permanent damage to the flocculant after being exposed to the heat and cold.

A liter of diluted Hydrofloc at 30 g l^{-1} was also stored at the various temperatures for four weeks. This sample was used in jar tests to determine the effect that the heat and cold had on the effectiveness of the flocculant over time. The soil was first sieved using a 10 mesh sieve to remove the larger aggregates. To represent the settling forebay to remove the sand and larger particles, the jars were first mixed for 30 seconds at 120 rpm and allowed to settle for 66 seconds. The settling time was calculated for a 0.05 mm diameter sand grain using the Stokes equation. After 66 seconds of settling, the supernatant liquid was poured off into another jar. Once the jar was brought up to two liters, 0.15 g l^{-1} flocculant was added and mixed for 5 seconds. After a settling time of one minute, a 20 ml sample was taken. The turbidity of the sample was immediately tested using a 2100Q Hach turbidity meter.

Determination of turbulent kinetic energy in the jar tests with the help geometric similitude studies

The formation and the breakage of the flocs is highly dependent on the turbulence generated by the mixing devices. The turbulence not only allows particle interactions to take place but high turbulence can also break the flocs due the shear force on the surface of the flocs. The kinetic energy that dissipates affects the size distribution of the flocs. The rate of dissipation of the kinetic energy 'ε' controls the size of the flocs. The rate of dissipation in the stirred tanks is not isotropic (Kresta, 1998). In a stirred tank like the jar test apparatus the shear or the turbulent kinetic energy is greater near the blade area and is reduces away in the region away from the blade in the bulk fluid (Bouyer et al, 2001; Cheng et al, 1997; Kresta, 1998). The basic objective of the geometric similitude study was to measure the local turbulent energy and see how it dissipates. Owing to the proportionality of the geometry of the actual and the prototype jar test apparatus, turbulence measured in the prototype could be used to deduce the values in the actual jar test apparatus.

A regular Jar test apparatus as shown in Figure 160 consists of a 2L square beaker with a flat blade impeller. The blade has the dimensions of 3 inches in width and 1 inch in height. The thickness of the blade is 1mm. For geometric similitude, the dimensions of the actual model and the prototype have to be proportional. Instead of using a 2L, square jar a round 2L beaker was used. A regular round beaker has an inner diameter of 4.6 inches. The ratio of the Diameter to the length of the blade was found out to be 1.5. The dimensions the actual jar test apparatus and the prototype are shown in Table 495. The picture of the prototype jar test apparatus is showed in the Figure 163.

Table 495: dimensions of the actual and the prototype jar test apparatus

Dimensional Parameter	Actual	Prototype
Diameter	4.6 inches	22.5 inches
Length of blade	3 inches	15 inches
Width of the blade	1 inch	5 inches

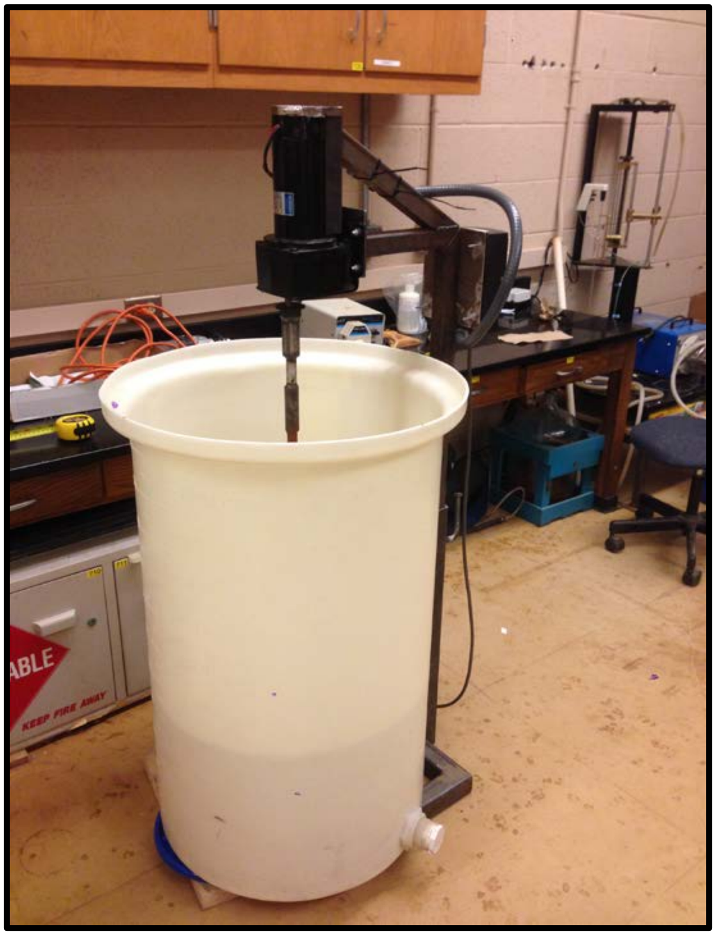


Figure 163: Picture of the prototype jar test apparatus

Method

Sontek YSI 16 MHz Acoustic Doppler Velocitimeter (ADV) was used to measure the velocities at 4 different depths: 1 inch, 2 inch, 3 inch and 4 inch. A depth greater than 4 inches was very close to the blade area. The ADV cannot measure velocities very close to any boundary as it picks up a lot of noise signals giving erroneous results. Since the movement of the blade is circular and the blade is centered to be at such turbulent energy dissipation in the upwards and the downward direction would be uniform and similar. Therefore, the measurements were taken only in the upward region of the jar test apparatus. The impeller was speed was set at 3 different speeds 18 rpm, 36 rpm and 54 rpm. At 72 rpm, the signal to noise ratios very measured to be very low, which would lead to erroneous measurements. Therefore, velocity measurement at higher speeds could not be taken. The impeller was allowed to stir up the soil and water mixture inside the tank to allow the turbulence to establish completely. The ADV was then inserted at mentioned depths and then velocity measurements were recorded on computer with the help of the Horizon ADV which is a data logging software for the ADV. After recording the velocities with the impeller moving for 1 minute the impeller was then stopped and the measurements were recorded for another 1 minute.

Results: Impacts of Physical Parameters on Turbidity Reduction Efficiency and Hydrofloc properties

Each parameter tested follows the same general trend as shown in Figure 164. At low mixing speed and low flocculant and sediment concentrations, the turbidity reduction is low. As each parameter is increased, the reduction in turbidity also increases until it peaks. The reduction will plateau and depending on the parameter the reduction in turbidity will eventually reach a point where a decrease in the turbidity reduction will occur.

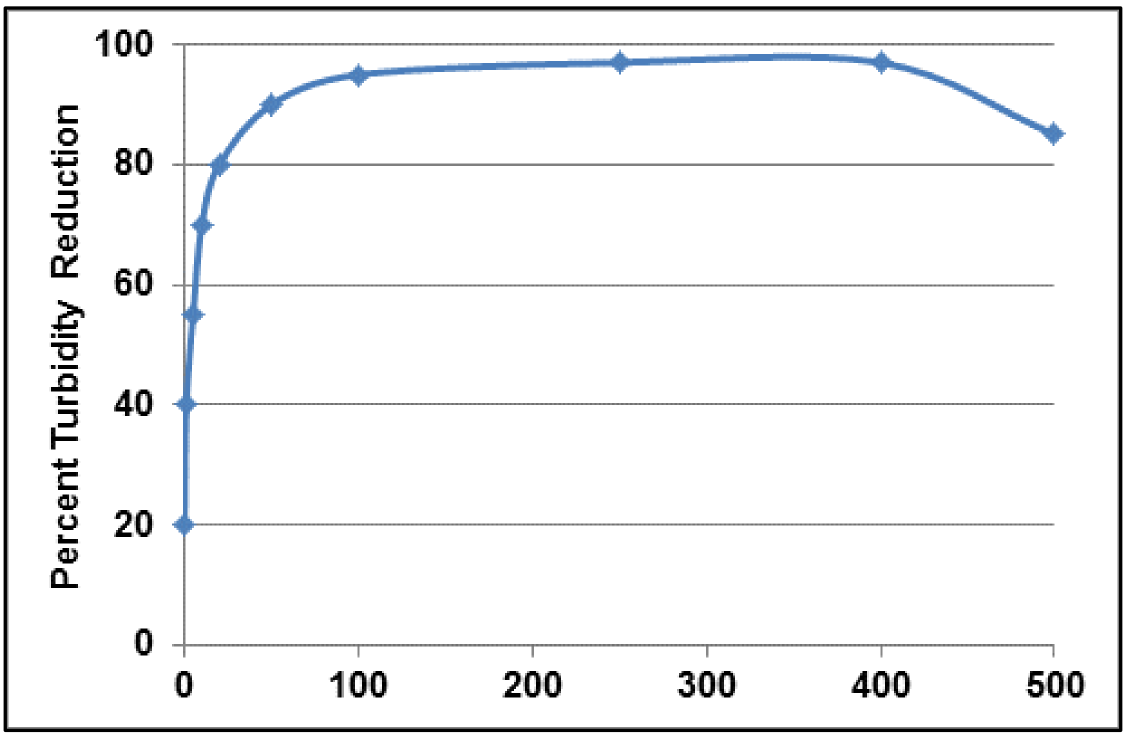


Figure 164. The general trend for each of the flocculation parameters. They begin with a small reduction in turbidity, increase, peak and then eventually decrease.

Mixing Speed

Mixing was tested at speeds ranging from 0-300 rpm on a Port A soil. For these tests, 0.15 g l^{-1} of flocculant was added and it was mixed for thirty seconds. A sample was taken after a five minute settling time. As mixing speed increases so does the percent turbidity reduction (Figure 165). The percent turbidity reduction is less than 30% when the solution is not mixed and increases to 75% when mixed at 60 rpm. The reduction peaked at 120 rpm and plateaus.

At low mixing speeds, the particles have less of a chance to collide and stick together. As the mixing speed increases, the number of particle collisions increase which then increases the particle flocculation and settling rate. If the speed or agitation continues to increase, floc breakage will eventually occur and therefore decrease the reduction in turbidity. The point where floc breakage occurs is a function of clay type and stickiness coefficient.

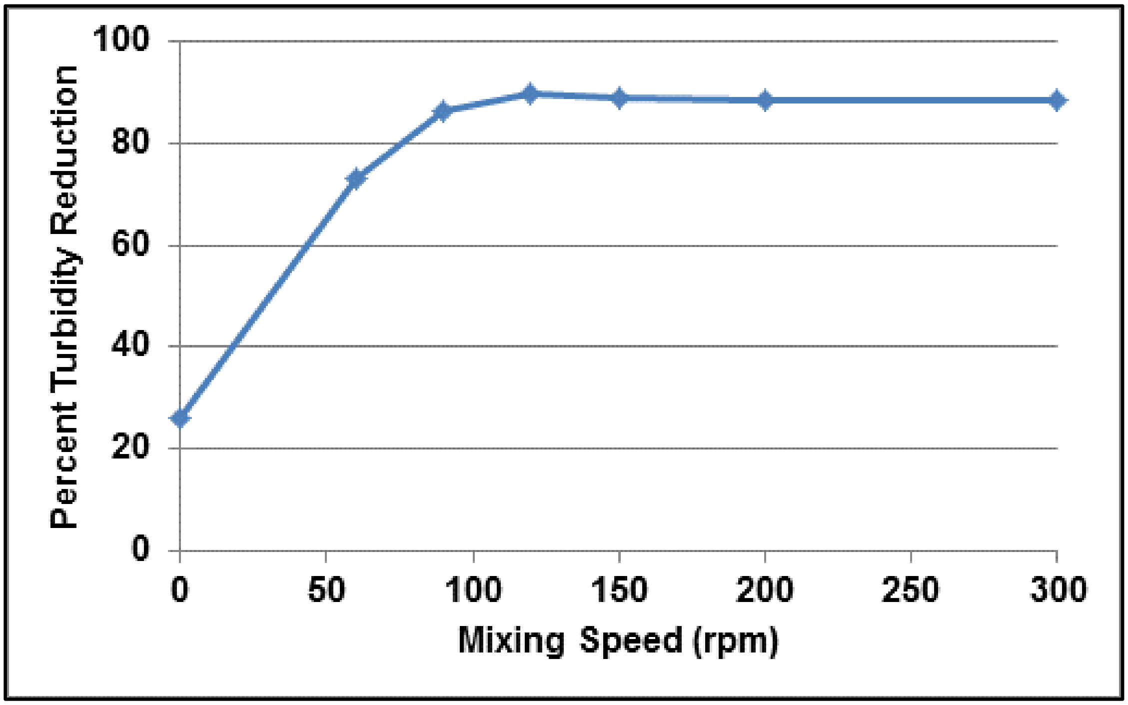


Figure 165. The percent turbidity reduction at mixing speeds ranging from 0-300 rpm.

Flocculant Concentration

Flocculant concentration was tested at concentrations ranging from 0.05-0.30 g l^{-1} Hydrofloc. For these tests, Port A and B soils were utilized. After the flocculant was added, the solution was mixed for five seconds. A sample was taken after a one minute settling time. As flocculant concentrations increase so does the percent turbidity reduction (Figure 166). The percent turbidity reduction is 75% at a concentration of 0.05 g l^{-1} and increases to over 80% at a concentration of 0.15 g l^{-1}, which is where the reduction peaked.

At low flocculant concentrations, there is not enough flocculant for all of the particles to stick together. As the concentration increases, the number of particles that stick together also increases which then increases the particle flocculation and settling rate. If the concentration continues to increase, charge reversal will eventually occur and therefore decrease the reduction in turbidity.

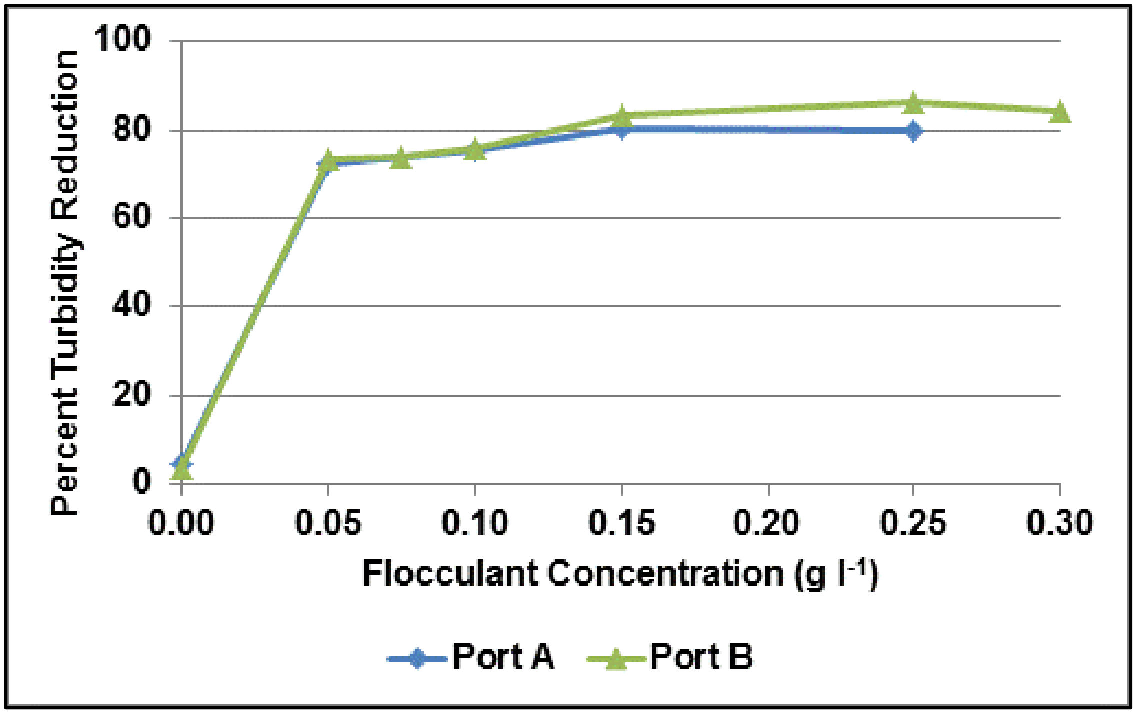


Figure 166. The percent turbidity reduction at flocculant concentrations ranging from 0.05-0.30 g l^{-1}.

Sediment Concentration

Sediment was tested at concentrations of 0.3 to 3.0 g l^{-1} on a Port A soil. For these tests, 0.15 g l^{-1} of flocculant was added and it was mixed for thirty seconds. A sample was taken after a five minute settling time. As sediment concentration increases so does the percent turbidity reduction (Figure 167). The percent turbidity reduction is less than 20% at a sediment concentration of 0.3 g l^{-1} and increases to 99% reduction at 3.0 g l^{-1}.

At low concentrations, the particles have less of a chance to collide and stick together. As the sediment concentration increases, the number of particle collisions increase which then increases the particle flocculation and settling rate. If the same amount of flocculant is added, but the concentration of sediment continues to increase, a point will be reached where the reduction in turbidity will decrease. This is because there will not be enough flocculant for all of the sediment particles.

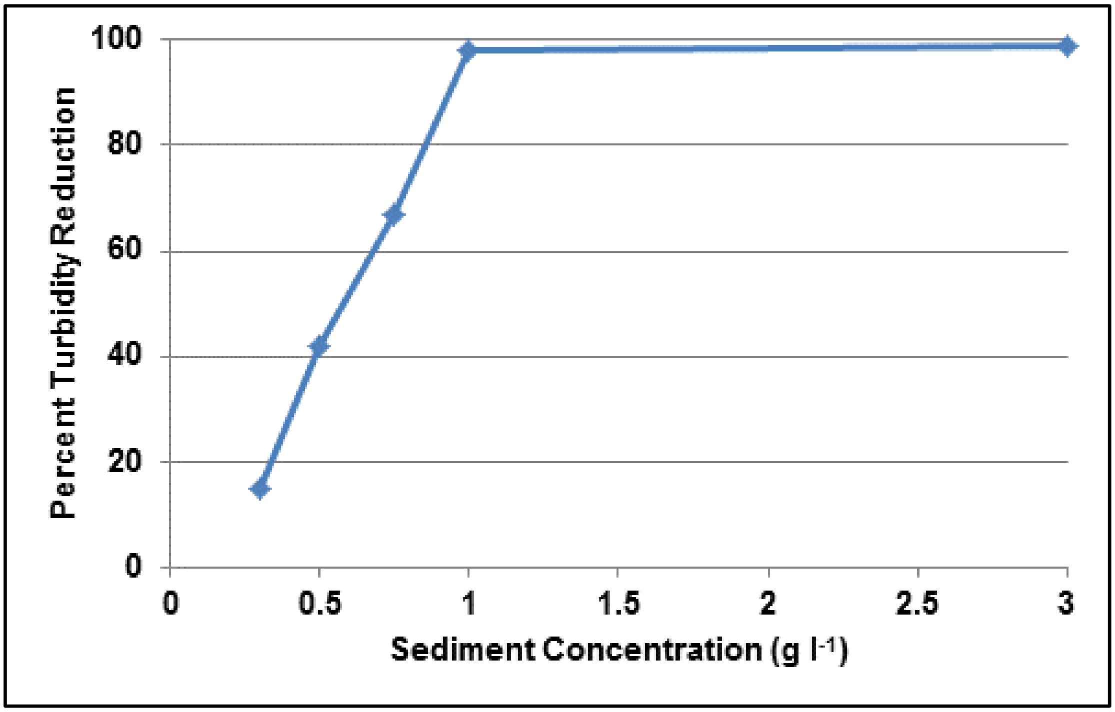


Figure 167. The percent turbidity reduction at sediment concentrations ranging from 0.3 to 3.0 g l^{-1}.

<u>Discussion</u>

As the mixing speed, flocculant concentration and sediment concentration increased, so did the reduction in turbidity. Though the parameters affect one another, they each followed the same trend. This general trend should be the same for different soils with only the slope and peak changing.

Results: Testing the properties of Hydrofloc 445L

The viscosities of Hydrofloc at dilutions of 1, 10 and 100 g l^{-1} and 100% Hydrofloc can be seen in Figure 168. At room temperature, the viscosities were 1, 7.5, 43.5 and 7,550 cp. The viscosities increased at cooler temperatures and decreased at warmer temperatures.

Figures 169 to 171 show the viscosities at 10 and 100 g l^{-1} and 100% Hydrofloc over a period of 100 day when stored at 4°C, 23°C and 50°C. The viscosity of the Hydrofloc stored at 4°C remained constant while there was a small decrease in the viscosity in the Hydroflow stored at room temperature. The drastic change is in the Hydrofloc stored at 50°C. After just one day stored at 50°C, the viscosity drops considerably from 45 cp to 25 cp for the diluted Hydrofloc of 100 g l^{-1}. The viscosity continues to drop to 3 cp. The results are similar for the diluted 10 g l^{-1} and 100% Hydrofloc.

Figure 172 illustrates the effect that temperature had on the effectiveness of the flocculant over a period of 28 days. Cold temperatures had no affect with the reduction in turbidity after 28 days being the same as it was after one day. While there was a small decrease in the effectiveness over time for the flocculant stored at room temperature, the results were much more dramatic for the flocculant stored at 50°C. After just one day of being exposed to the elevated temperatures, the turbidity reduction decreased from 85% to 45%. The effectiveness continued to decline until after 28 days, only a 30% reduction was obtained.

Discussion

The viscosity of the flocculant changed when exposed to various temperatures. If the flocculant injection system is calibrated using the viscosity at room temperature, the system will either over or under inject when the temperature changes. This coupled with the negative affect the heat has on the effectiveness of the flocculant over time, makes it imperative that the flocculant be insulated some way, especially in the summer, to keep the temperature of the flocculant relatively constant.

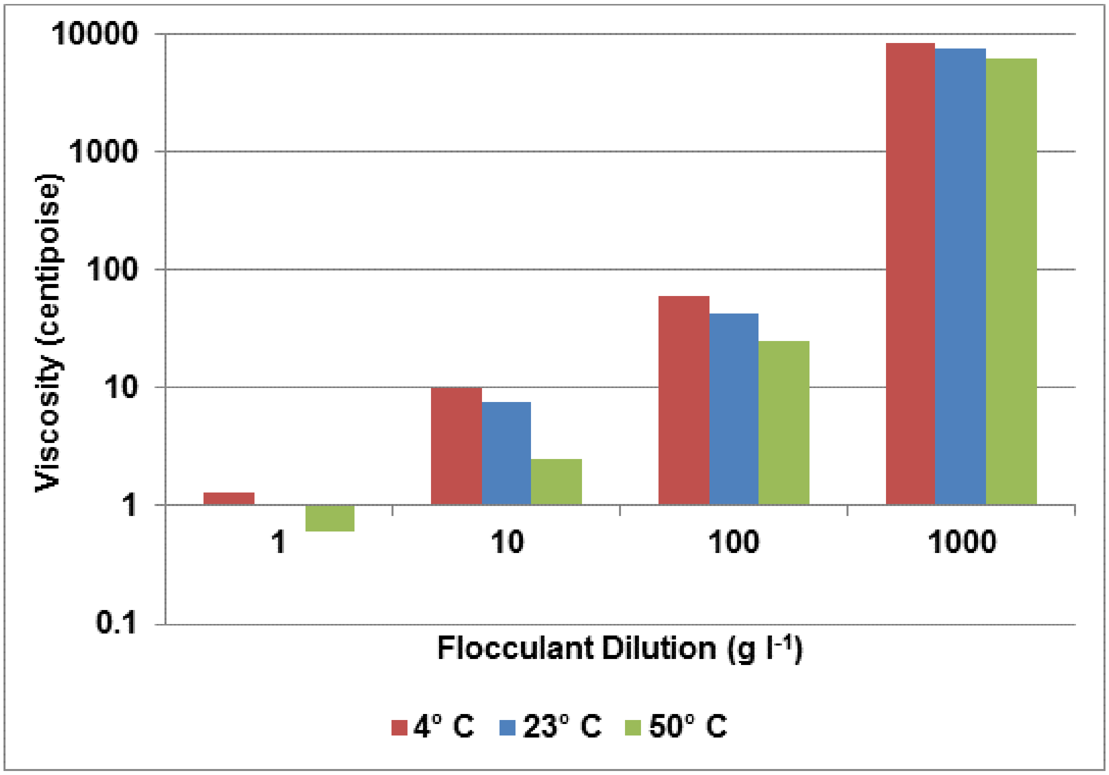


Figure 168. The viscosities on a log scale of Hydrofloc at dilutions of 1, 10 and 100 g l^{-1} and 100% at 4°C, 23°C and 50°C.

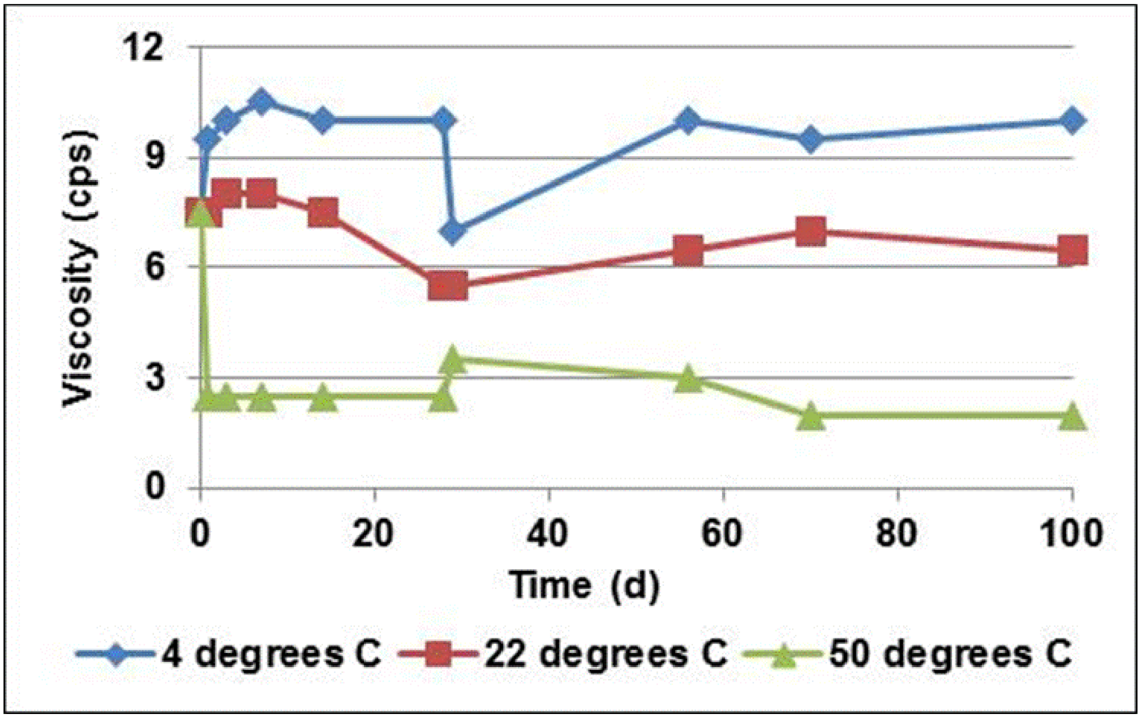


Figure 169. The viscosity of Hydrofloc diluted to 10 g l^{-1} stored at 4°C, 23°C and 50°C over a 100 day period.

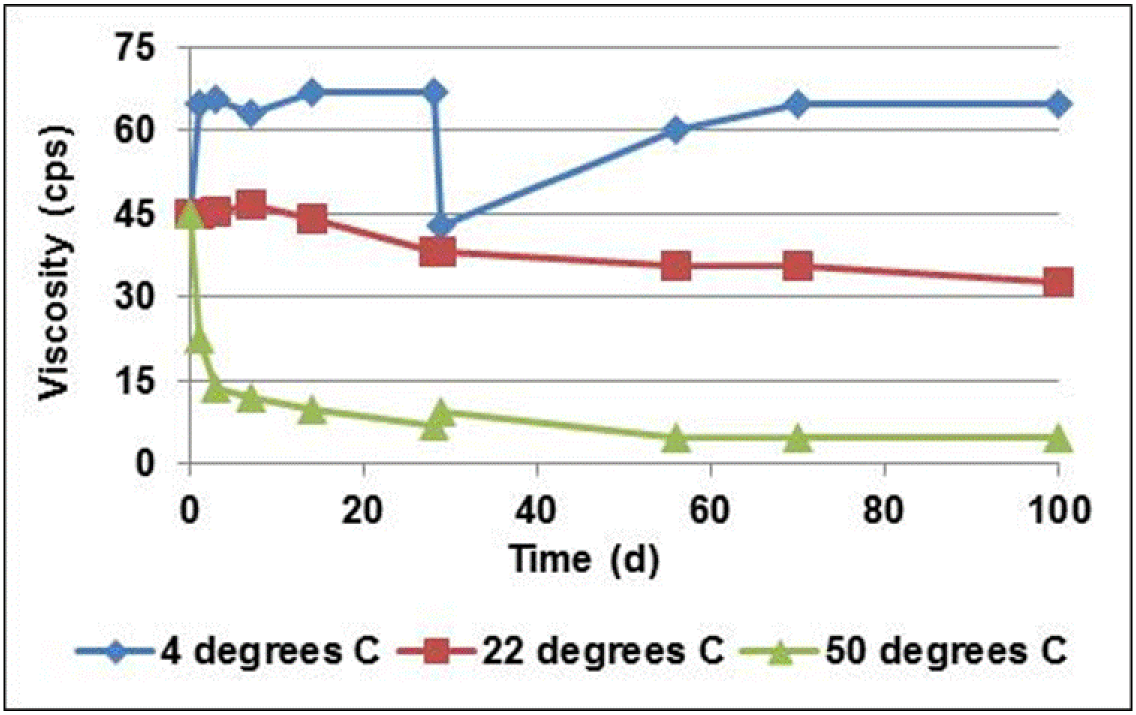


Figure 170. The viscosity of Hydrofloc diluted to 100 g l^{-1} stored at 4°C, 23°C and 50°C over a 100 day period.

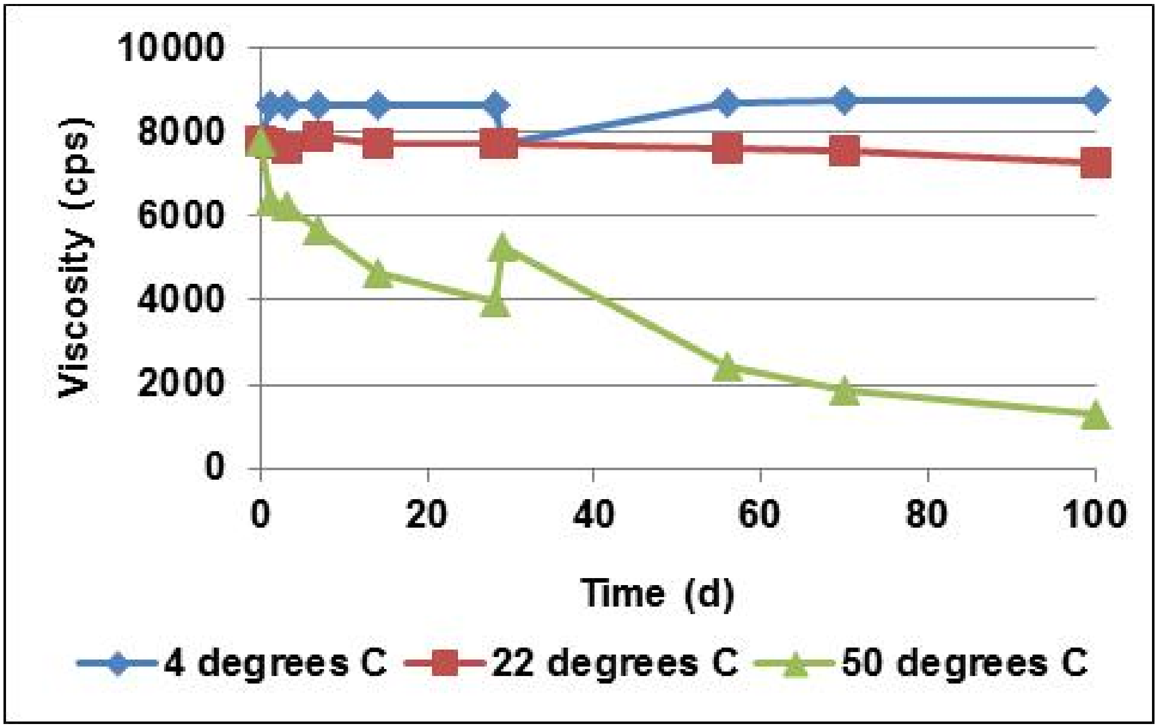


Figure 171. The viscosity of 100% Hydrofloc stored at 4°C, 23°C and 50°C over a 100 day period.

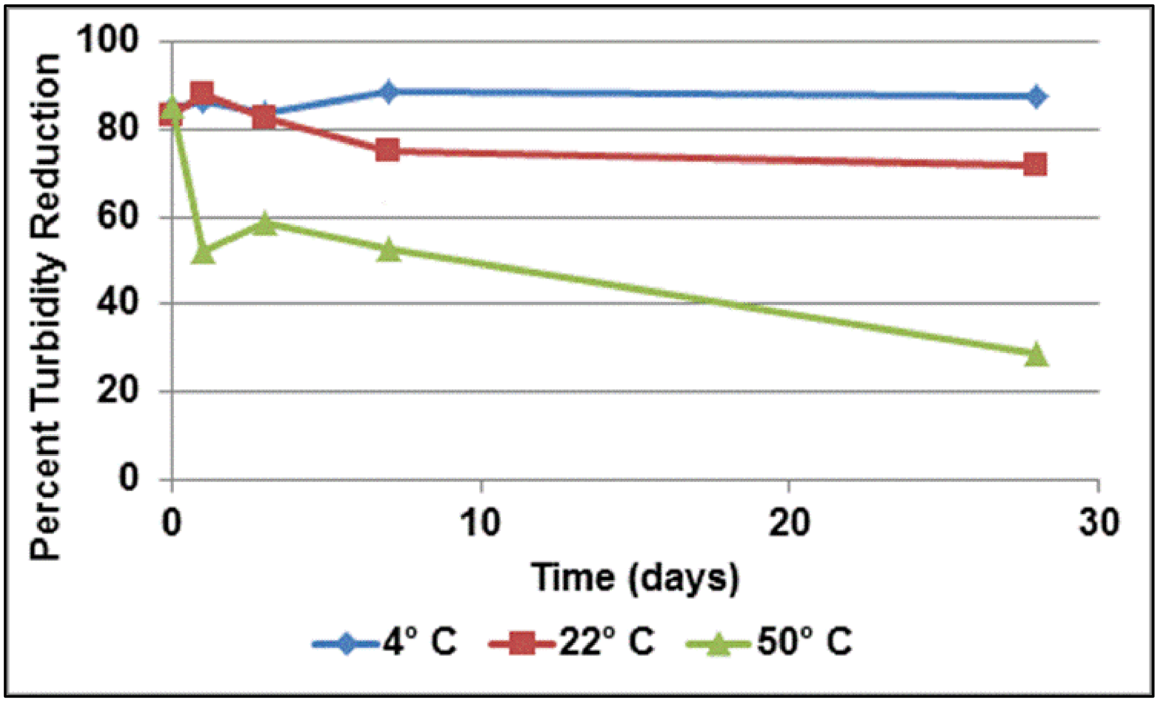


Figure 172. The effectiveness of Hydrofloc over a 28 day period when stored at 4°C, 23°C and 50°C.

Results: Determination of turbulent kinetic energy in the jar tests with the help geometric similitude studies

Determination of Reynold’s number:

For the speeds at which the jar tests were conducted, the Reynolds number are as shown in Table 496 and the Reynold’s number calculated for the prototype jar test apparatus are as shown in Table 497.

Table 496: Impeller Reynold’s number for the actual jar test apparatus

Impeller Speed rpm)	N (rps)	D (m)	Kinematic viscosity ‘v’ (m^2/s)	Re	Peripheral velocities (cm/s)
18	0.3	0.0762	0.000001004	1734.99	7.18
30	0.5	0.0762	0.000001004	2891.65	11.96
36	0.6	0.0762	0.000001004	3469.98	14.36
54	0.9	0.0762	0.000001004	5204.97	21.54
60	1	0.0762	0.000001004	5783.30	23.93
90	1.5	0.0762	0.000001004	8674.96	35.90
120	2	0.0762	0.000001004	11566.61	47.87
150	2.5	0.0762	0.000001004	14458.26	59.84
200	3.33	0.0762	0.000001004	19277.68	79.79
300	5	0.0762	0.000001004	28916.53	119.69

Table 497: Impeller Reynold's number for the actual jar test apparatus

Impeller Speed rpm)	N (rps)	D (m)	Kinematic viscosity 'v' (m^2/s)	Re	Peripheral velocities (cm/s)
18	0.3	0.381	0.000001004	43374.80	35.90
36	0.6	0.381	0.000001004	86749.60	71.81
54	0.9	0.381	0.000001004	130124.40	107.72

As you can see the ratio of the of the blade diameter of the prototype to the actual jar test apparatus is 5:1. Therefore, the Reynolds number is the prototype are 25 times larger than the ones in actual jar test and the peripheral velocities of the impeller in the prototype are 5 times greater than in the actual jar test apparatus. Therefore, the kinematic similitude is dependent upon the ratio of the length of the blade in the prototype to that of the actual jar test apparatus. During the mixing period the mean velocities measured in the prototype with the help of the ADV in the X, Y and Z direction are as shown below in Table 498.

Table 498: Mean velocities measured in the prototype with the help of the ADV.

Rotational Speed (rpm)	Mean stream wise velocity measured during mixing (cm/s)
18	17.15
36	39.8
54	54.64

The mean velocities measured in the X-direction (stream wise) are approximately 0.5 times the peripheral velocities. Therefore, the mean velocities measured in the x-direction for the actual jar test can also be deduced as **0.5 times** the peripheral velocities owing to the similitude the impeller geometry.

Impeller Zone kinetics

The depth of the water above the blade was 6 inches. The measurement taken by inserting the probe at 3 inches and 4” below the water surface was assumed to be in the impeller region. The turbulent velocity in this region (De Silva, 2006) is given by:

$$u = \left(\frac{2k}{3}\right)^{1/2}$$

where: *u: turbulent velocity (cm/s)*

k: turbulent kinetic energy (cm^2/sec^2)$= 0.5*(u^2+v^2+w^2)$

u,v,w: are mean square fluctuating velocities in x,y,z direction

and the characteristic velocity is given by

$$u_0 = \pi ND$$

where: u_0 = *characteristic velocity (cm/s)*

N= rotational speed (revolutions per second)

D= Diameter of the impeller (cm)

For the impeller zone there exists a relationship between the turbulent velocity and the characteristic velocity which is given as

$$u = u_0 f_1$$

Here f1 is an arbitrary coefficient which is dependent upon the diameter of the blade and the Cartesian coordinates where the measurement are taken. Measurements were taken at a single spot for consistency and repeatability. Table 499 shows the values of u, u0 and f1 obtained at both 3 inches and 4 inches depth from the surface of the water.

Table 499: Characteristic and turbulent velocities calculated for the prototype jar test

Speed	**u(4”)**	**u(3”)**	**u_o (4”)**	**u_o (3”)**	**f_1 (4”)**	**f_1 (3”)**
18	3.1	2.89	35.90	35.91	0.086	0.081
36	6.37	6.89	71.82	71.82	0.089	0.096
54	9.67	10.31	107.73	107.73	0.090	0.096

The integral length scales of the eddies within the impeller zone are said to be equal to the diameter of the impeller (De Silva, 2006). Therefore, the integral length scale ‘l’ in the impeller zone can be assumed 38.1cm. Now, the integral length scale is also given by the equation below

$$l = \frac{k^{3/2}}{\varepsilon}$$

where: ε= turbulent energy dissipation rate (cm^2/sec^3)

Also the dissipation scale based in the impeller characteristic 'ε_0'

where l= integral length scale (cm)

D= diameter of the impeller (cm)

The turbulent energy dissipation rate 'ε' can be derived as

$$\varepsilon = \varepsilon_0 \frac{Af_1^3}{g_1}$$

Here g1 is an arbitrary coefficient, which depends upon the geometry of the impeller. The above equations were solved and the values obtained for the various variables is summarized in the Table 500.

Table 500: Values of the epsilon obtained in the impeller zone

Speed	K (4")	K (3")	g_1(4")	g_1(3")	ε_0	ε(4")	ε (3")
18	54.71	44.41	0.54	0.54	1215.244	1.435874	1.165524
36	476.43	602.05	0.54	0.54	9721.949	12.5046	15.8019
54	1665.38	2014.38	0.54	0.54	32811.58	43.71088	52.87082

Applying the principles of geometric similitude, the integral length scale in the actual jar test would be equal to the impeller diameter which, would be equal to 7.62 cm. Thus the turbulent energies and the dissipation rates calculated in the impeller zone are as shown in Table 501

Table 501: Values of the turbulent energy and turbulent energy dissipation rate estimated in the actual jar test

Speed	u_0 (cm/s)	u (cm/s)	K(cm^2/sec^2)	ε_0(cm^2/sec^3)	ε(cm^2/sec^3)
18	7.181681	0.642667	0.619531	48.60974	0.064507
36	14.36336	1.285333	2.478123	388.8779	0.516058
54	21.54504	1.928	5.575776	1312.463	1.741696
100	39.89823	3.57037	19.12132	8335.004	11.06092
200	79.79645	7.140741	76.48527	66680.03	88.48732
300	119.6947	10.71111	172.0919	225045.1	298.6447

Bulk Zone Kinetics

The turbulent quantities decay as a function of the distance in the axial direction from the impeller. The distance of 1" and 2" from the surface of the water was considered as bulk fluid (De Silva, 2006). The equations are essentially same except that the now the turbulent dissipation rate and the turbulent velocity are a function of (z/D) where z is the vertical distance away from the impeller.

For the bulk fluid zone relationship between the turbulent velocity and the characteristic velocity which is given as

$$u = u_0 \left(\frac{z}{D}\right)^p f_2$$

where u: turbulent velocity (cm/s)

u_0 = characteristic velocity (cm/s)

z= vertical distance away from the impeller

D= impeller diameter

Here again f2 is an arbitrary coefficient. Now since u is dependent on the vertical distance. Using the turbulent velocity at two different locations that is 1" and 2" depth.

Table 502: Characteristic and the turbulent velocities for the bulk zone

Speed	u(2”)	u(1”)	u_o (2”)	u_o (1”)	f_2	f_2
18	2.15	1.74	35.91	35.91	0.0036	0.003
36	4.91	4.38	71.81	71.81	0.0041	0.0037
54	8.92	5.82	107.72	107.72	0.0051	0.0033

$$\varepsilon = \varepsilon_0 \frac{A f_2^3}{g_2}\left(\frac{z}{D}\right)^{3p-q}$$

and

$$l = D\left(\frac{z}{D}\right)^{q} g_2$$

In addition, we know that the integral length scale is given by equation

$$l_0 \sim \frac{k_0^{3/2}}{\varepsilon}$$

Table 503 summarizes the values obtained for the turbulent energy and the turbulent energy dissipation rates. Figure 173 shows the change in the dissipation rate with speed

Table 503: Characteristic and the turbulent velocities for the bulk zone

Speed	**K (2”) cm^2/sec^2**	**K (1”) cm^2/sec^2**	**ε_0 cm^2/sec^3**	**ε(2”) cm^2/sec^3**	**ε (1”) cm^2/sec^3**
18	18.48	9.6	1215.244	0.934360626	0.26349034
36	217.71	154	9721.949	11.12867925	4.202805432
54	1306.81	362	32811.58	66.72578813	9.860204161

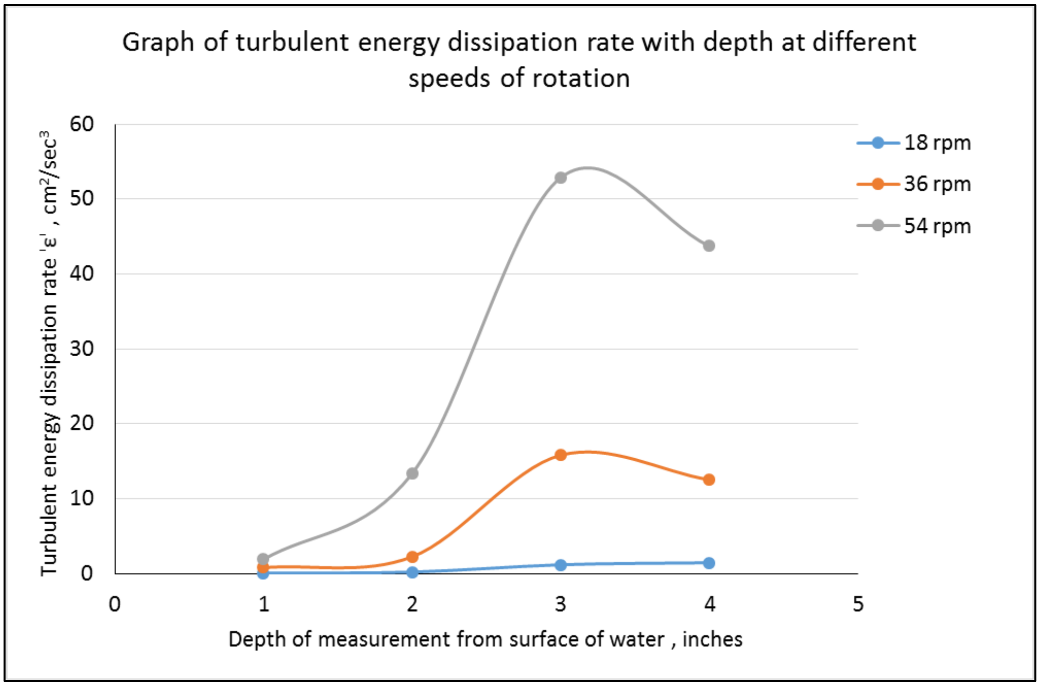


Figure 173: Graph of turbulent energy dissipation rate measured with depth for different rotational speeds

Discussion:

From the result presented, the turbulent energy dissipation rate is maximum near the impeller zone and it decreases as we move away from the impeller zone. The measurement of 4” below the surface of the water corresponded to measurement in between the blade and the tank wall. From previous research work done in this field, higher dissipation rates are observed at the edge of the blade as it can be seen from the estimated epsilon values for 3” depth. Because of the geometric similitude, the kinetic energy and the turbulent energy dissipation rates can be determined using the same function for different depths in the actual jar test apparatus. The turbulent energy dissipation rate is actually not only the function of space but is also a time dependent phenomenon. Therefore for future work it is recommended to do a complete spectral analysis of the energy within the whole system and then account for the energy balances based on both time and the length scales of turbulence.

Description of the Field Turbidity Reduction Device

The basic flocculation system configuration is comprised of a settling forebay with trash removal, a flow activated flocculent dosing apparatus, a turbulent flow mixing apparatus, and a settling basin. The principle of operation is a relationship between forebay stage and discharge through a flow control structure (flume), which permits the activation of a series of float valves (Label 1 in Figure 1) positioned at predetermined stages to maintain flocculant concentrations in a desired range. Flocculant flows under gravity from the housing (Label 5 in Figure 1) through the float valve dosing system. The apparatus may use pipes, weirs, flumes, etc. as flow control structures, and a variety of valves as the dose actuating mechanism. The developed prototype uses a metal cutthroat flume (Label 2 in Figure 1) as the flow control structure due to its ability to discharge a wide range of flows, and its tolerance to high backwater conditions without impacting the stage-discharge relationship. The purpose of the mixing structure (Label 3 in Figure 1 and 2) is to generate turbulent flow conditions following flocculant injection in order to enhance interaction between flocculant molecules and suspended particles. Proper mixing is critical to facilitate efficient flocculation, and therefore, is an integral part of the system.

Fixed structures have been designed and employed in the wastewater industry to induce highly efficient mixing conditions in pipe systems. These structures provided the basis for the open channel mixing system that was designed and constructed in the prototype. However, any structure which generates turbulence will aid in flocculation. The key is producing the correct amount of turbulence under a wide range of flow conditions. Additionally, a flow control structure in the sedimentation basin downstream of the injection and mixing apparatus provides stage control within the mixing system, and the development of a hydraulic jump (Label 4 in Figure 1) at the entrance to the mixing system. A hydraulic jump is a highly turbulent flow phenomenon, which also contributes to mixing within the designed system.

The flume used in the prototype apparatus included two stilling wells, one on each side, which house the floats that actuated the float valves. The holes on either side of the mouth of the flume allowed water to flow in and out of the stilling wells (Label 1 in Figure 3). As water levels in the mouth of the flume and stilling wells increased, the floats rose and opened the float valves (Label 2 in Figure 3). By positioning the floats at staggered heights with reference to the flume bottom, an automated, passive dosing mechanism actuated by flow was achieved.

The prototype plumbing system was designed to convey liquid flocculent to the float valves, and then to the diffuser (Label 3 in Figure 3), which distributed flocculent across the width of the channel. The gate valves (Label 4 in Figure 3) incorporated into the plumbing provided a simple and easy means of calibration for flocculent flow rates, which allow for variable dosing rates.

The described prototype, therefore was able to satisfy the previously stated needs and objectives, and is unique in the following ways:

1. Flow control structure uses a stage-discharge relationship with prepositioned float valves that allow passive, standalone flocculent dosing to actuate and terminate at designed discharges.
2. Employs gate valves in a passive flocculant dosing apparatus to control flocculent flow rates during operation.
3. Uses open channel mixing structures developed based on existing inline static mixers for pipes.
4. Uses a backwater control structure to induce a hydraulic jump at a desired location to facilitate flocculent mixing.

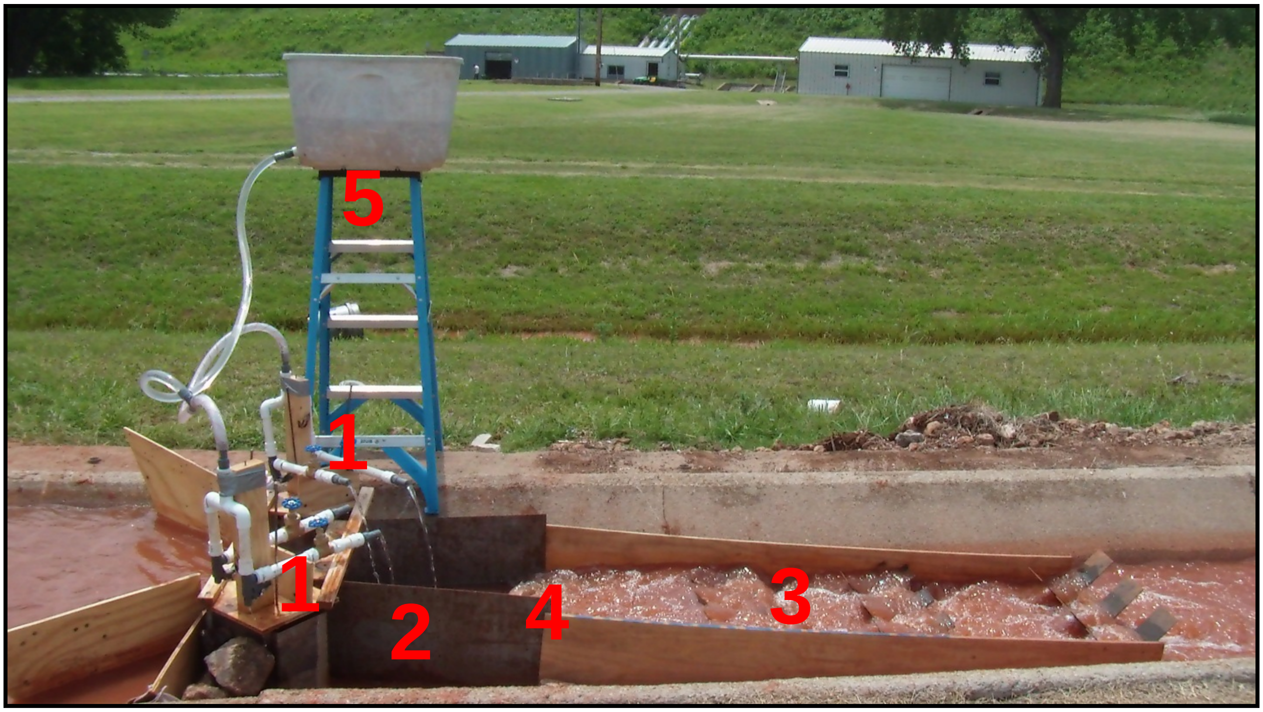


Figure 174. Prototype turbidity reduction system including (1) float valves for flocculant dosing, (2) metal cutthroat flume for flow measurement, (3) mixing structure, (4) hydraulic jump upstream of the mixing structure, and (5) flocculant tank.

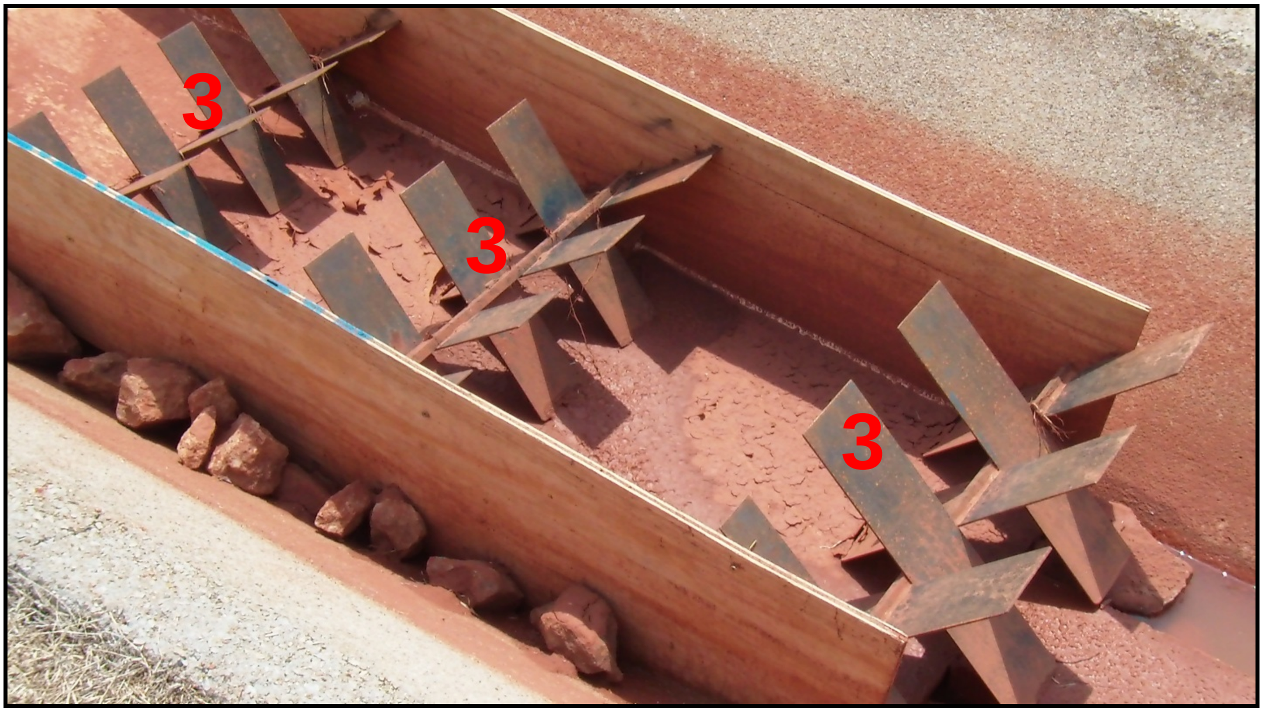


Figure 175. Mixing structures for the Oklahoma turbidity reduction system labeled as (3) to correspond to the numbers in Figure 1.

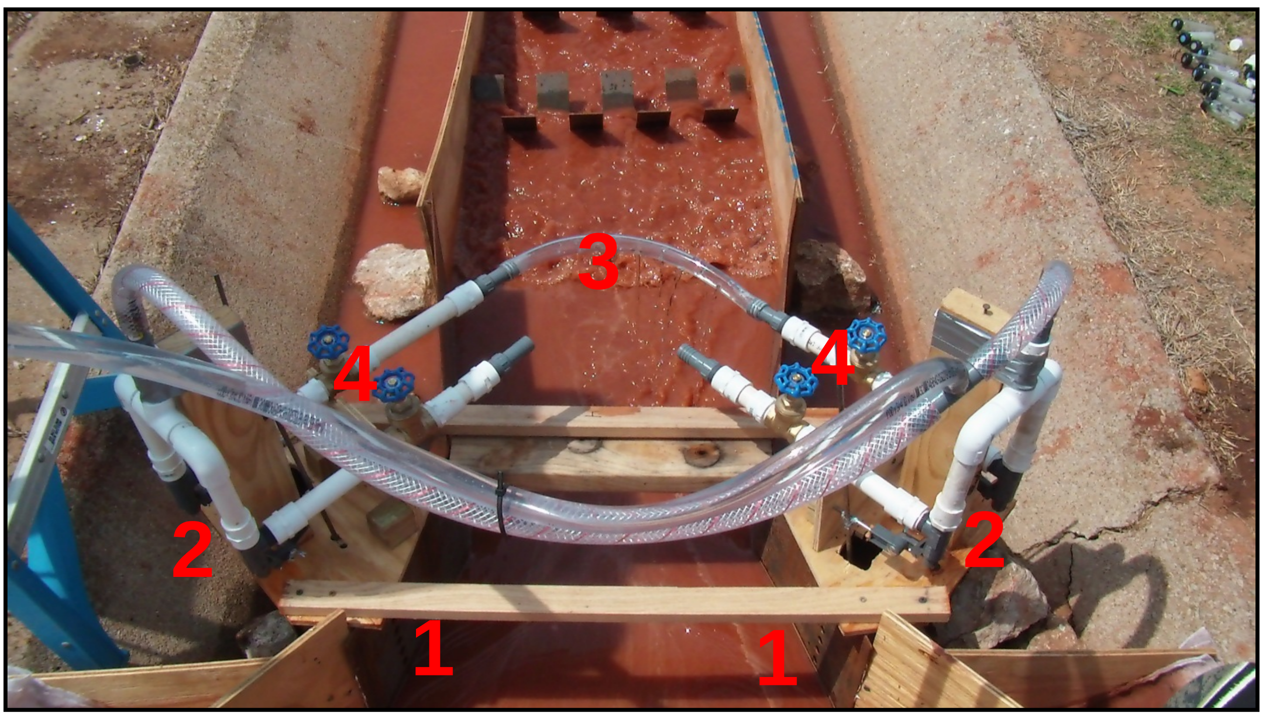


Figure 176. Injection plumbing system for the Oklahoma turbidity reduction system, including (1) stilling wells on either side of the cutthroat flume, (2) float valves, diffuser system for even flocculent injection, and gate valves for calibration of flocculant dosing rates.

Refinement of Passive Flocculent Injection and Mixing Device

The OSU passive flocculant injection and mixing device previously developed was refined to be better deployed in field situations. Specifically, we have further refined the valve system for flocculant injection, and developed plans for modular deployment of the system.

Modular Design Plans

The first update to the OSU passive flocculant injection and mixing device involved created a modular version to enable it to be readily deployed in field situations (Figure 15). The pieces of the apparatus that will be constructed for easy installation are the (1) steel walls; (2) flume with stilling wells, and flocculant injection valves; (3) downstream channel with static mixers; and, (4) flocculant injection system. The walls will be constructed thick enough to withstand the flow of water coming to the system and pounded or buried in the channel bottom with rock on the back side. The flume will be attached to the steel walls on the downstream site. The channel with static mixers will be connected to the downstream end of the flume. Rocks will be placed on the downstream end of this channel to prevent scouring of the soil at the end of the channel. The flocculant injection system will be comprised of a tank with flocculant and vinyl tubing that is connected to the valves inside the stilling wells.

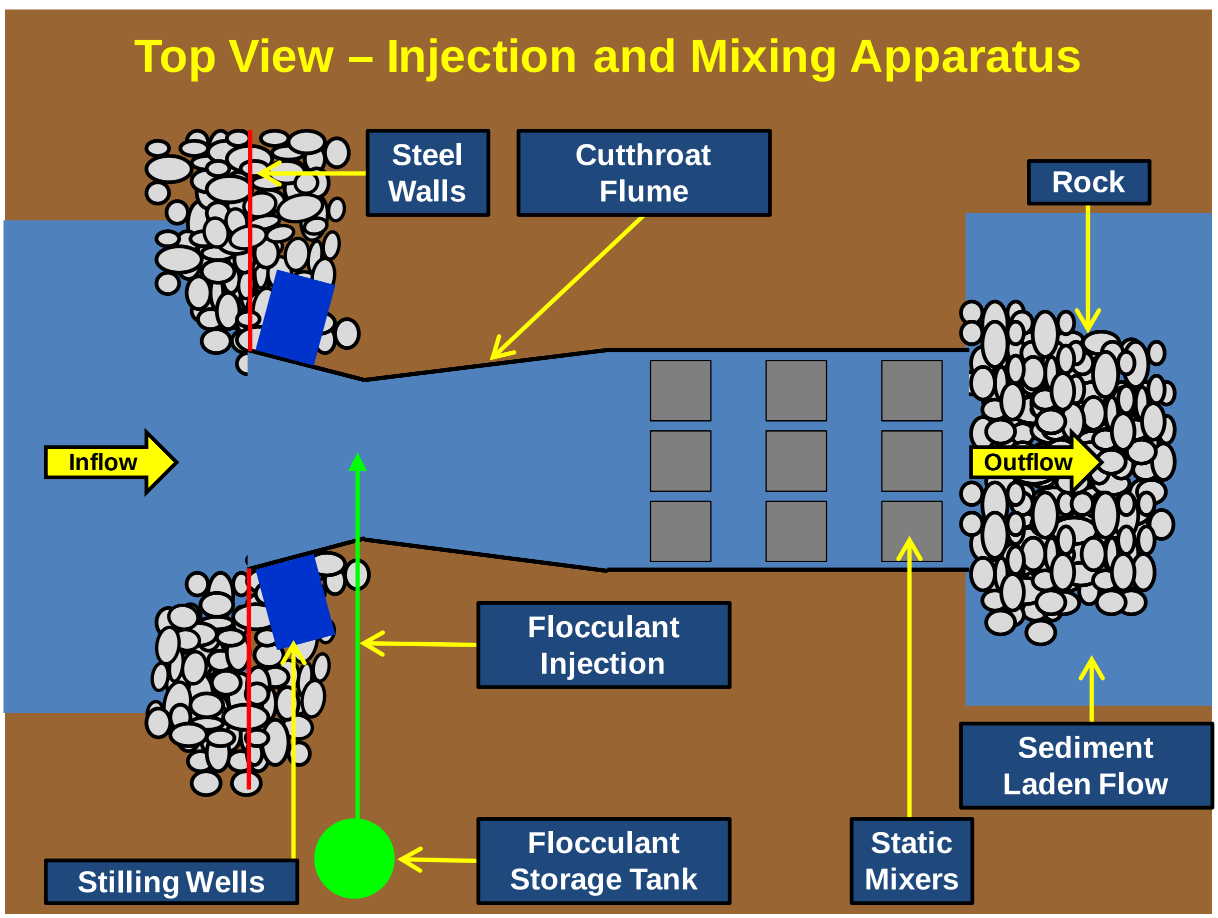


Figure 177. Top view of the OSU flocculant injection and mixing apparatus.

Updated Valve and Float System

The original prototype of this system included valves that were simple toilet valves to inject the flocculant at different flow levels. The improved version of this system has brass float and ball valves to flocculant injection rate. The connections between the flocculant holding tank and valves are PVC and flexible hose. Linkages were added to the float valve arms to increase durability and keep the floats perpendicular to the water. Custom floats made from plastic bottles attached to the linkages with threaded rod. The threaded rod is adjustable to change float height in the stilling well. This enables the system to adapt to various flocculation injection concentrations and target treatment flow rates. The valve in float mechanisms are piped through a steel plate that attaches to the wall of the stilling well. Figure 178 shows the updated valve and float system injecting flocculant into flowing turbid water during a field experiment.

Figure 178. Updated valve and float system

Field Experiments of the Passive Flocculent Injection and Mixing Device on a mimicked construction site

Introduction

A field experiment was set up to test the passive flocculent injection system. The initial intent was to capture rainfall events but no rain events were recorded after installation. As an alternative to rainfall, the site was modified to include a water and soil mixing apparatus and a lined channel that would empty into the forebay. Several experiments were conduction by pumping water through the channel while simultaneously mixing in soil to mimic stormwater runoff. The turbid water was then treated by the flocculation injection system to evaluate turbidity reduction and Suspended Solid Concentration (SSC) reduction.

Site Layout

The series of settling basins were designed for a 1-acre bare soil field, similar to what would be found on a construction site. The soil was classified as a Port series based on the soil survey. The site layout included a forebay followed by the flocculent injection and mixing system and finally a settling basin that exited of site (Figure 179). The flocculent injection system installed at the field site was described previously as the updated valve and float system. That system was designed specifically for the field experiments.

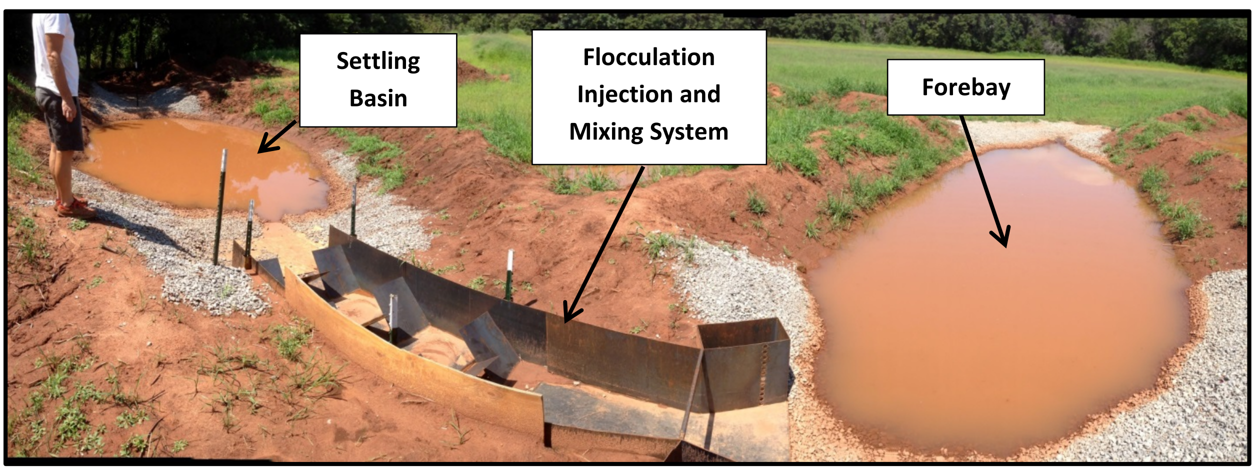


Figure 179. Field site layout for field experiments

Methods

The field experiments consisted of control runs (i.e., no flocculant added) and flocculant runs. The soil used in the experiment was gathered on site. The experiments consisted of 3 control runs, 5 flocculant runs with varying turbidity, and 3 flocculant runs with varying flocculant concentrations as seen in Table 1. Turbidity and SSC sampling rates are also included on Table 1. The level of turbidity was altered for various runs by changing the sediment loading rate. Each experiment had a constant 500 gallon per minute flow rate from a pump.

Table 504. Experimental Setup of the field experiments.

Date	Run #	Flocculant Concentration (mg/L)	Turbidity Sampling Rate (Hz)	Sediment Concentration Sampling Interval (min)
11/8/2013	1	0	2	3
11/8/2013	2	0	2	3
11/8/2013	3	0	2	3
11/11/2013	1	0.15	2	3
11/11/2013	2	0.15	2	3
11/11/2013	3	0.15	2	3
11/11/2013	4	0.15	2	2
11/11/2013	5	0.15	2	2
11/20/2013	1	0.025	2	2
11/20/2013	2	0.05	2	2
11/20/2013	3	Max rate for system, not quantified	2	2

To run an experiments, water was pumped from Lake Carl Blackwell and injected into a barrel. The barrel was loaded with soil from site to create turbidity. The loading rate was targeted between 2 and 3, 5-gallon buckets per minute. This soil was poured into the barrel, mixed by the force of the 500 gallons per minute water flow, and then released into a constructed and lined channel that emptied in to the forebay (Figure 180).

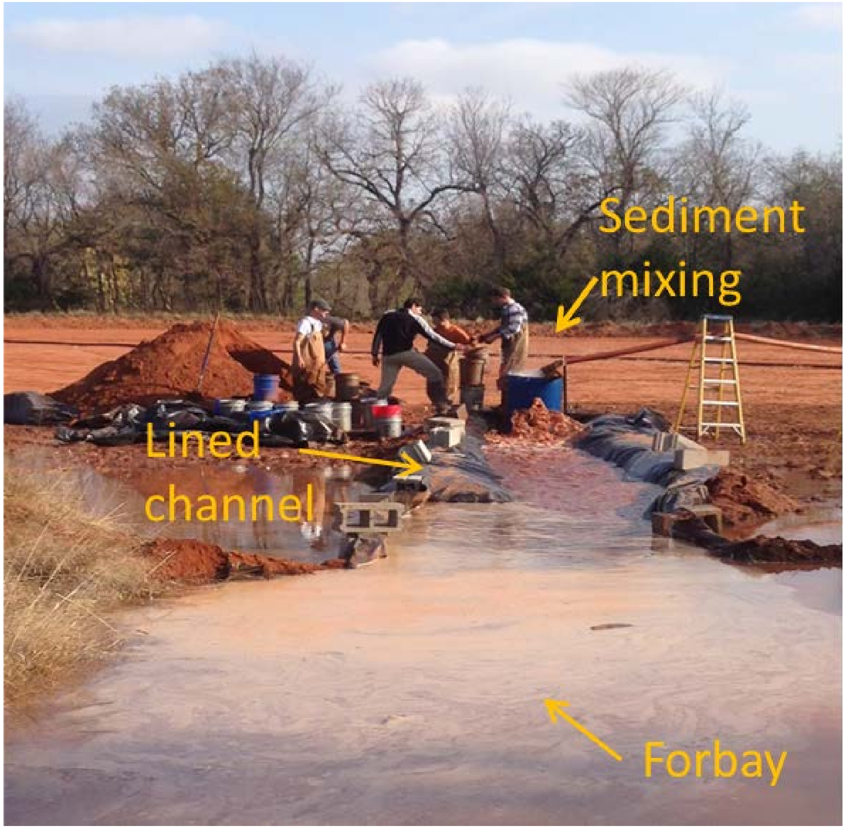


Figure 180. Pump injection, soil mixing, and water conveyance to forebay setup for field experiments

Figure 181 shows each location horizontally along the site layout where turbidity was measured. The turbidity levels were monitored at the mouth of the flume in the forebay (blue dot), at the exit of the flume (green dot), at the midpoint of the settling basin (red dot), and at the settling pond outlet (orange dot). Hydrolab MS5 Sondes measured turbidity at the flume entrance and settling basin locations. A Hach SOLUTAX turbidity meter was deployed at the flume exit. And the settling basin outlet turbidity was measured with a Global Water WQ770-B. Grab samples were collected at the mouth of the forebay and at the settling basin outle (Fgiure 182). The grab samples were collected in 100-ml poly bottles that were analyzed for suspended sediment concentration (SSC) in the laboratory.

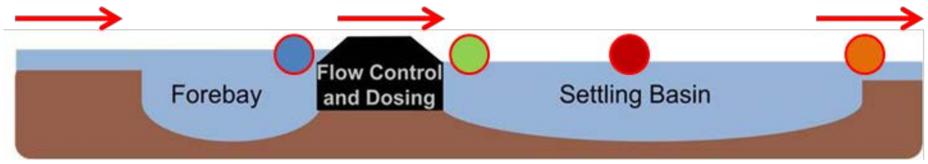


Figure 181. Locations of turbidity meters in the forebay and settling basin for field experiments

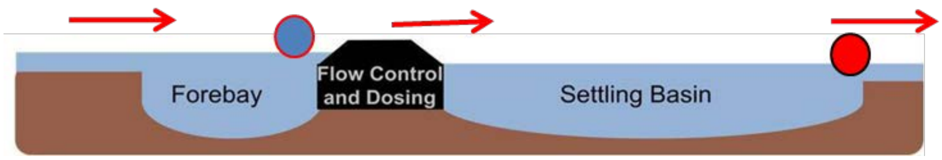
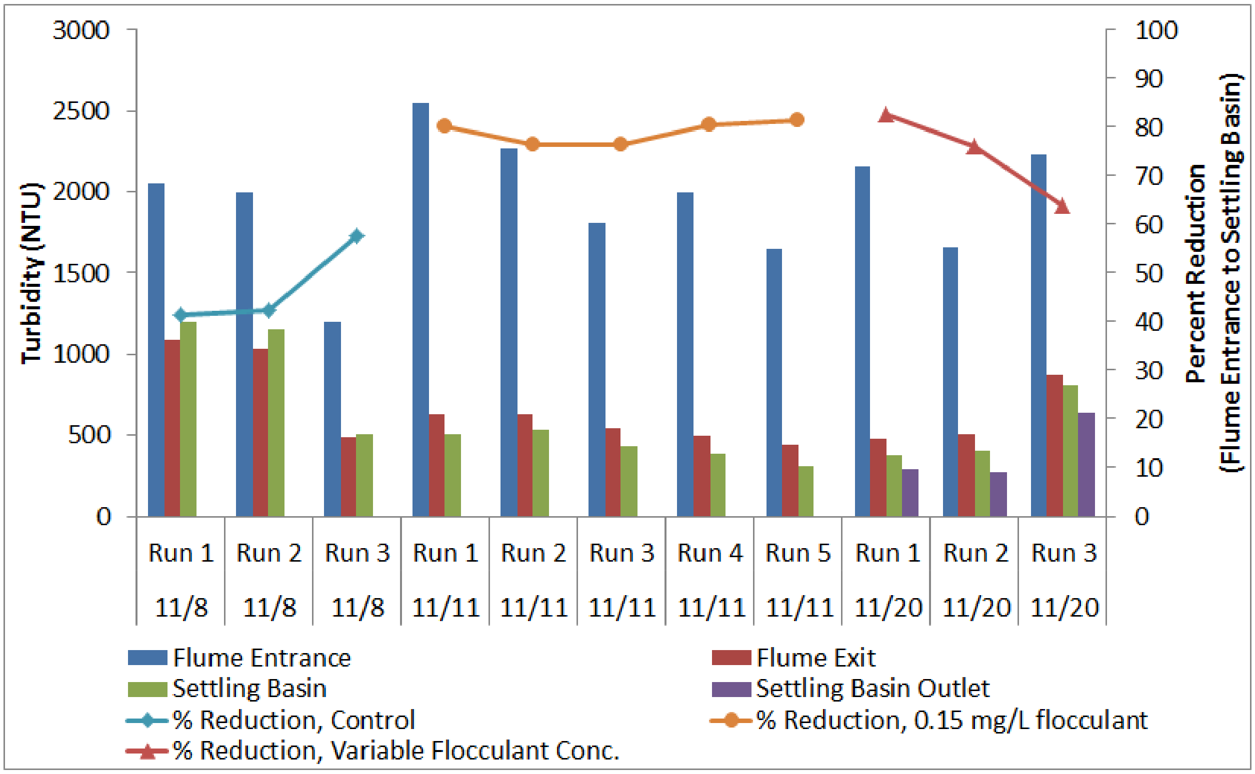


Figure 182. Location of grab samples in the forebay and settling basin for field experiments

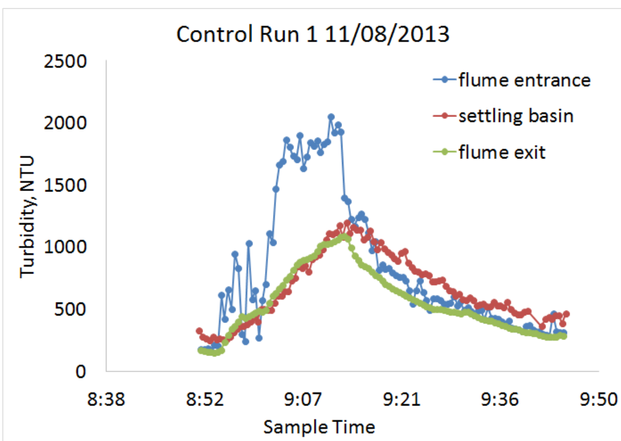
Results and Discussion

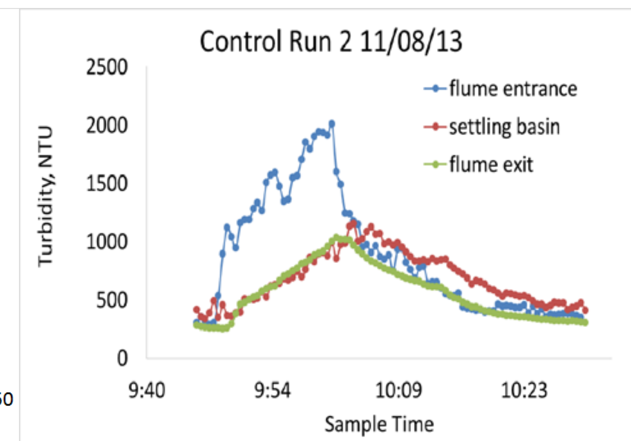
Turbidity

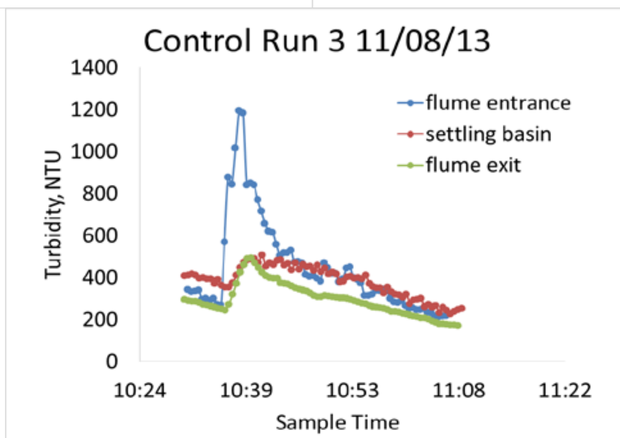
Date	Run #	Flume Entrance	Flume Exit	Settling Basin	Settling Basin Outlet
11/8/2013	1	2050	1090	1200	-
11/8/2013	2	2000	1030	1152	-
11/8/2013	3	1200	491	508	-
11/11/2013	1	2550	624	505	-
11/11/2013	2	2270	632	537	-
11/11/2013	3	1812	539	429	-
11/11/2013	4	2000	499	388	-
11/11/2013	5	1650	439	307	-
11/20/2013	1	2160	477	377	293
11/20/2013	2	1660	505	399	273
11/20/2013	3	2230	873	802	634

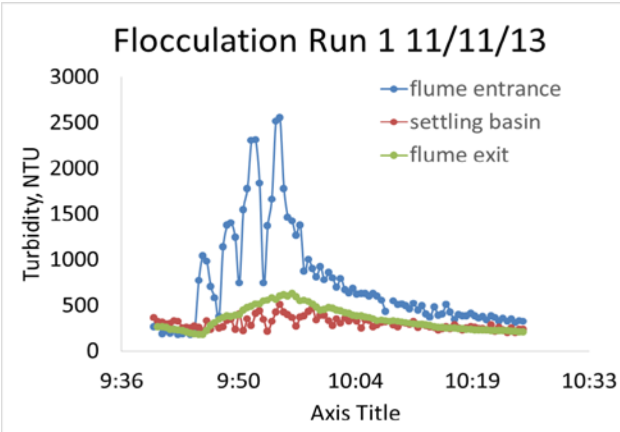


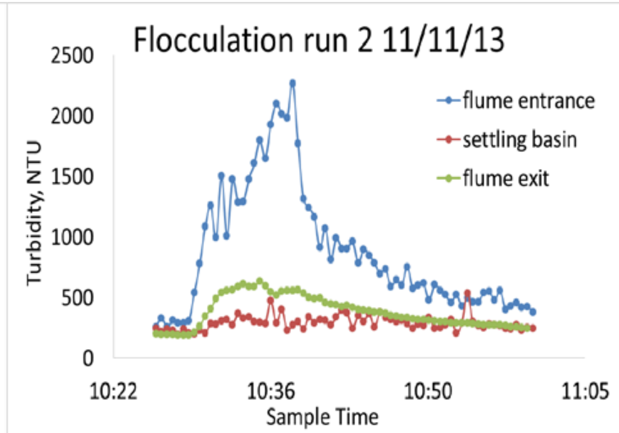
Turbidity (NTU)
3000
2500
2000
1500
1000
500
0
Percent Reduction
(Flume Entrance to Settling Basin)
100
90
80
70
60
50
40
30
20
10
0
Run 1 11/8
Run 2 11/8
Run 3 11/8
Run 1 11/11
Run 2 11/11
Run 3 11/11
Run 4 11/11
Run 5 11/11
Run 1 11/20
Run 2 11/20
Run 3 11/20
Flume Entrance
Flume Exit
Settling Basin
Settling Basin Outlet
% Reduction, Control
% Reduction, 0.15 mg/L flocculant
% Reduction, Variable Flocculant Conc.

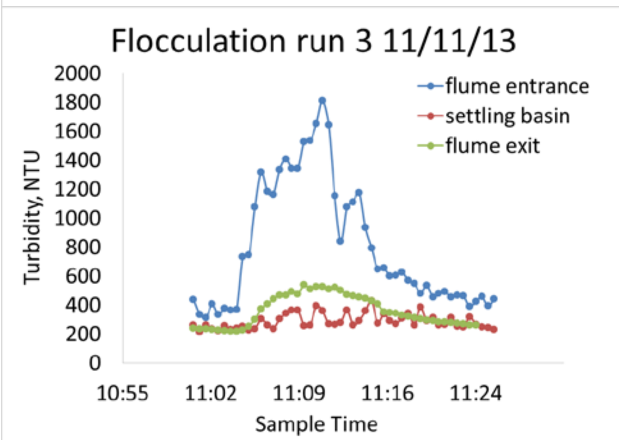

Control Run 1 11/08/2013
Turbidity, NTU
2500
2000
1500
1000
500
0
8:38
8:52
9:07
9:21
9:36
9:50
Sample Time
flume entrance
settling basin
flume exit

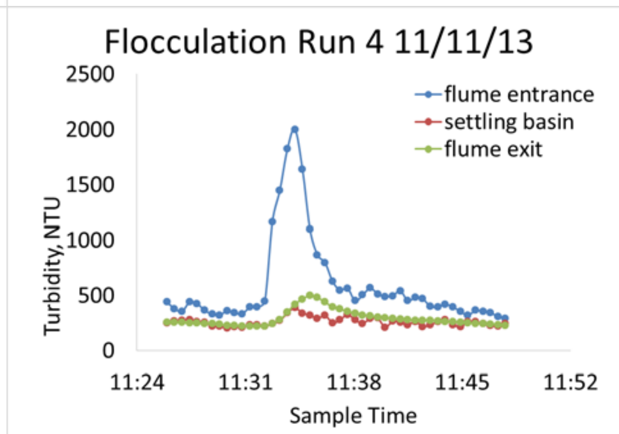

Control Run 2 11/08/13
Turbidity, NTU
2500
2000
1500
1000
500
0
9:40
9:54
10:09
10:23
Sample Time
flume entrance
settling basin
flume exit

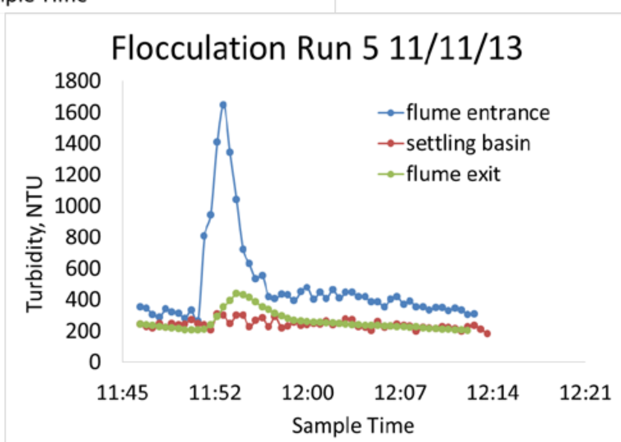

Control Run 3 11/08/13
Turbidity, NTU
1400
1200
1000
800
600
400
200
0
10:24
10:39
10:53
11:08
11:22
Sample Time
flume entrance
settling basin
flume exit

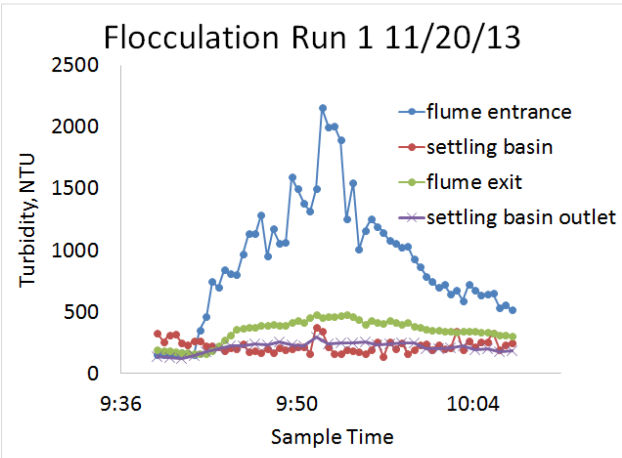

Flocculation Run 1 11/11/13
Turbidity, NTU
3000
2500
2000
1500
1000
500
0
9:36
9:50
10:04
10:19
10:33
Axis Title
flume entrance
settling basin
flume exit

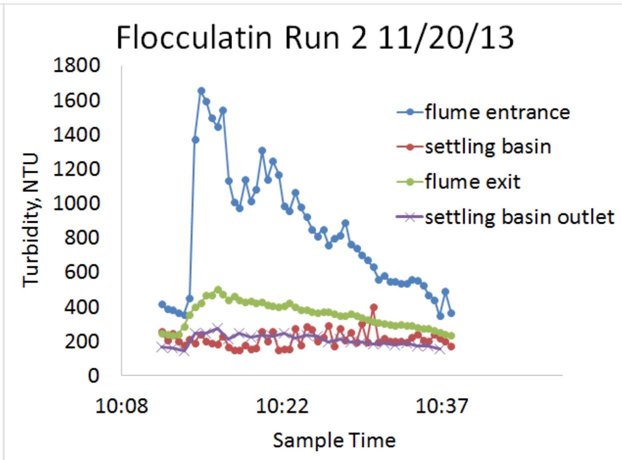

Flocculation run 2 11/11/13
Turbidity, NTU
2500
2000
1500
1000
500
0
10:22
10:36
10:50
11:05
Sample Time
flume entrance
settling basin
flume exit

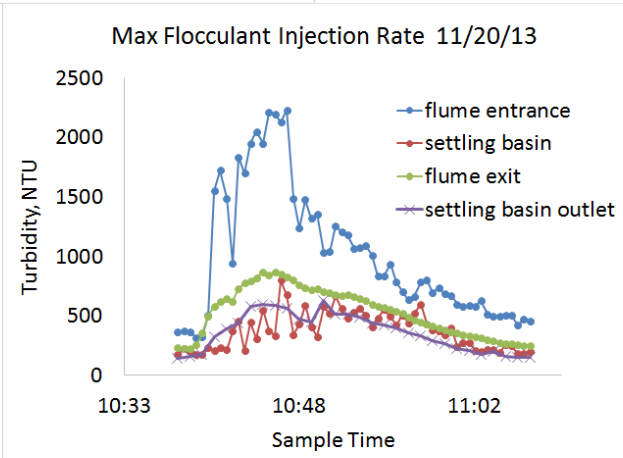

Flocculation run 3 11/11/13
Turbidity, NTU
2000
1800
1600
1400
1200
1000
800
600
400
200
0
10:55
11:02
11:09
11:16
11:24
Sample Time
flume entrance
settling basin
flume exit


Flocculation Run 4 11/11/13
Turbidity, NTU
2500
2000
1500
1000
500
0
11:24
11:31
11:38
11:45
11:52
Sample Time
flume entrance
settling basin
flume exit

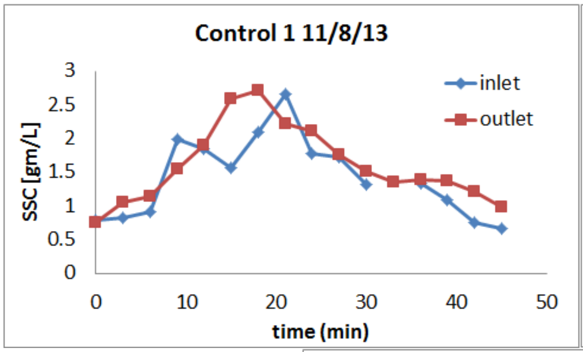

Flocculation Run 5 11/11/13
Turbidity, NTU
1800
1600
1400
1200
1000
800
600
400
200
0
11:45
11:52
12:00
12:07
12:14
12:21
Sample Time
flume entrance
settling basin
flume exit

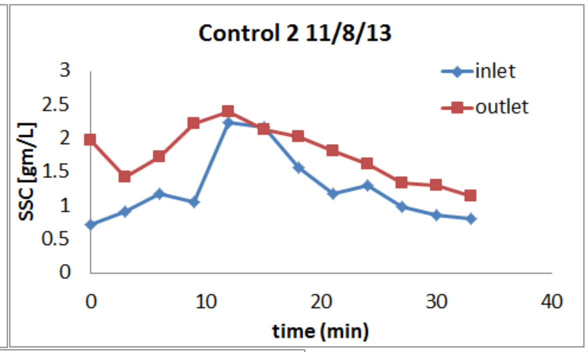

Flocculation Run 1 11/20/13
2500
2000
1500
1000
500
0
9:36
9:50
10:04
Sample Time
Turbidity, NTU
flume entrance
settling basin
flume exit
settling basin outlet

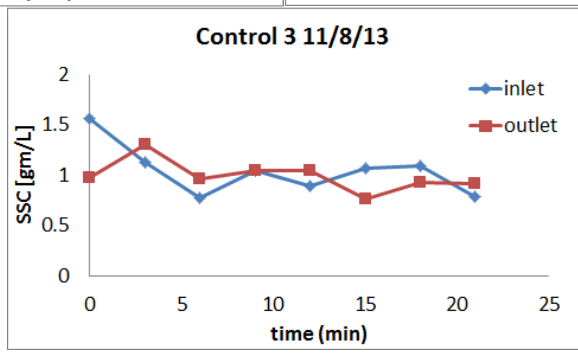

Flocculatin Run 2 11/20/13
1800
1600
1400
1200
1000
800
600
400
200
0
10:08
10:22
10:37
Sample Time
Turbidity, NTU
flume entrance
settling basin
flume exit
settling basin outlet

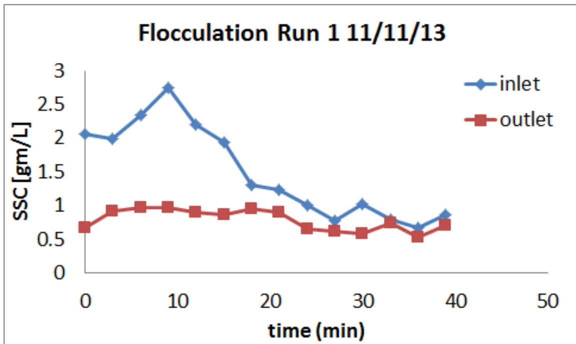

Max Flocculant Injection Rate 11/20/13
2500
2000
1500
1000
500
0
10:33
10:48
11:02
Sample Time
Turbidity, NTU
flume entrance
settling basin
flume exit
settling basin outlet

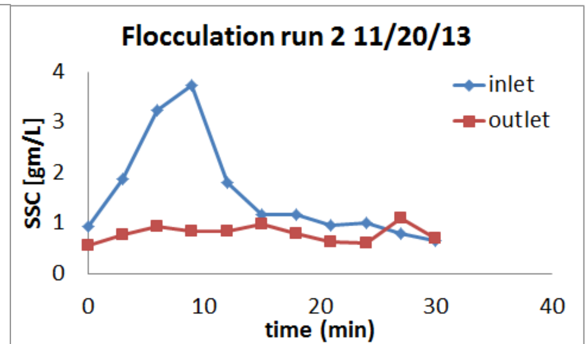
Suspended Sediment Concentration

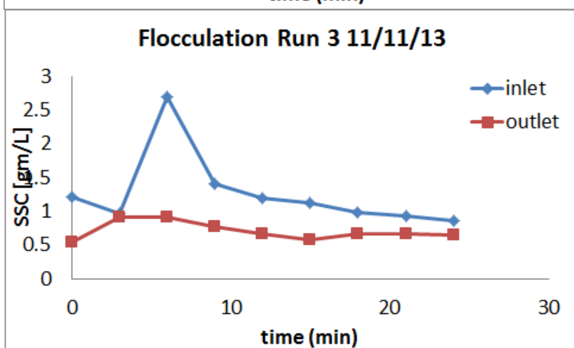


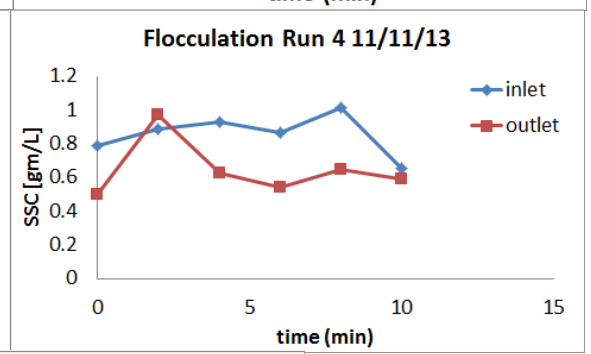


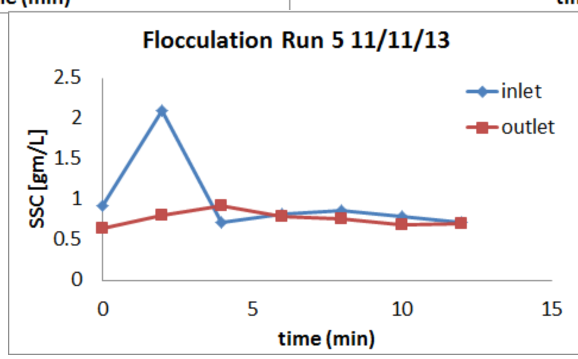


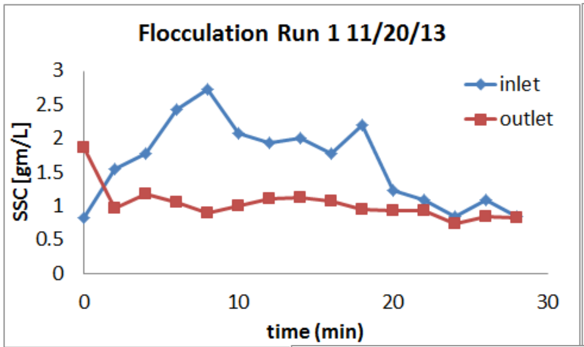

Flocculation Run 1 11/11/13
SSC [gm/L]
time (min)
inlet
outlet
0
0.5
1
1.5
2
2.5
3
0
10
20
30
40
50

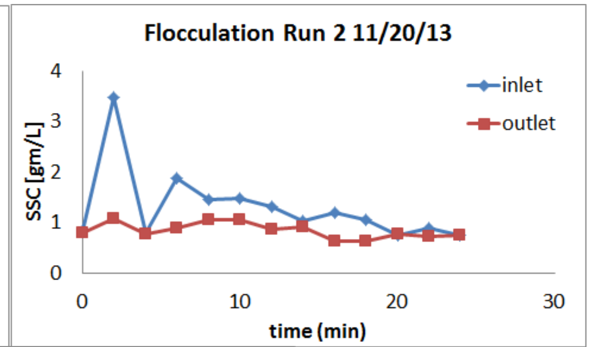

Flocculation run 2 11/20/13
SSC [gm/L]
time (min)
inlet
outlet
0
1
2
3
4
0
10
20
30
40

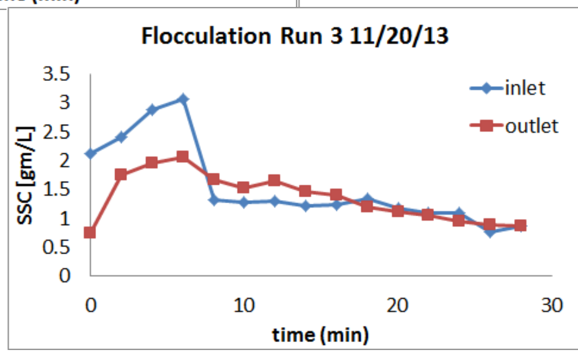

Flocculation Run 3 11/11/13
SSC [gm/L]
time (min)
inlet
outlet
0
0.5
1
2
2.5
3
0
10
20
30


Flocculation Run 4 11/11/13
SSC [gm/L]
time (min)
inlet
outlet
0
0.2
0.4
0.6
0.8
1
1.2
0
5
10
15


Flocculation Run 5 11/11/13
SSC [gm/L]
time (min)
inlet
outlet
0
0.5
1
1.5
2
2.5
0
5
10
15


Flocculation Run 1 11/20/13
SSC [gm/L]
time (min)
inlet
outlet
0
0.5
1
1.5
2
2.5
3
0
10
20
30


Flocculation Run 2 11/20/13
SSC [gm/L]
time (min)
inlet
outlet
0
1
2
3
4
0
10
20
30


Flocculation Run 3 11/20/13
SSC [gm/L]
time (min)
inlet
outlet
0
0.5
1
1.5
2
2.5
3
3.5
0
10
20
30

Conclusions

The three objectives of this project have been completed. The stickiness coefficients for Port, Port B, Kamie B, Stephenville B and Norge B have been summarized in Table 504.

Table 505: Summary of the stickiness coefficient for Port A and Port B soils.

Soil Type	Stickiness Coefficient
Port A	0.38-0.84
Port B	1.15 -1.5
Kamie B	0.82-1.5
Stephenville B	1.25-1.5
Norge B	1.1-1.5

Maximum sediment removal efficiency of 52% was observed for Stephenville B soil. Kamie B soil showed the maximum potential for reduction in turbidity. The turbidity reduction of 82% was measured for Kamie B soil. Higher stickiness coefficient values were observed for Port B, Kamie B, Stephenville B and Norge B. All these soils showed high sediment removal efficiencies. Port A soil recorded low stickiness coefficient values. This can be attributed to the fact that Port A had lower clay content and higher organic content typical of the A horizon. A horizon is closer to the surface and therefore there is greater chance of the finer clays in the soil of being washed away in storm events and therefore the In comparison to Port B, which is same soil but from B horizon (12 to 36 inches below surface), Port A had lower sediment removal capacities. There is no clear distinction whether that sediment removal efficiency was greater at the high velocity gradient runs for all the soils. The flume experiment methodology was successfully developed to determine the stickiness coefficients for the five soils. The flocculation model algorithms developed using the spreadsheets could be converted into a better, more user-friendly model using languages like Visual Basic, which can provide more flexibility in designing flocculation systems for sediment control in stormwater runoffs from construction sites.

Turbidity modeling studies have helped in establishing relationship between the suspended sediment concentrations in stormwater runoff and the turbidity. From the experimental investigations, it was shown that the turbidity has a power relationship with suspended sediments belonging to individual particle classes (sand, silt, clay). Future work in this field would be to establish a relationship between turbidity and suspended sediments concentration, which would include all the particle classes (sand, silt, clay, small aggregates and large aggregates).

Preliminary jar test procedure carried out helped in analyzing the parameters affecting the performance of the flocculant. It can be shown that sediment concentration, speed of mixing and flocculant concentration play an important role in turbidity reduction. At a constant flocculant dosage, at low sediment concentrations turbidity reduction is poor since there is not enough sediment to flocculate. The reduction in the turbidity increases with increase in the sediment concentration and then plateaus off to remain constant. Similar trends in turbidity reduction were also observed for mixing speed and flocculant concentration. From the tests it was always observed that as the temperature increases, the flocculant becomes less viscous and eventually becomes ineffective. This preliminary but details jar test investigations helped in establishing a flocculant dosage concentration for both the field and the flume experiments.

Geometric similitude studies done on the jar tests helped in understanding and estimating local turbulent energy dissipation rates within the jar tests based upon the observations in geometrically similar prototype apparatus. For future work these local turbulent energy dissipation rates can be compared to those measured in the field and the flume. Since the local turbulent dissipation rate affects the size distribution of the flocs. This comparison would help in accurately predicting flocculation efficiencies in the laboratory jar test apparatus.

Finally, the field injection and mixing system has been refined so that it is more easily deployed at construction sites by developing a modular approach to the system and updating the valve system for flocculant injection. By using the field system combined with the computer program and input parameters determined from the flume experiments, ODOT can now estimate the flocculation and turbidity reduction efficiency of the system at their construction sites with these soils.

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