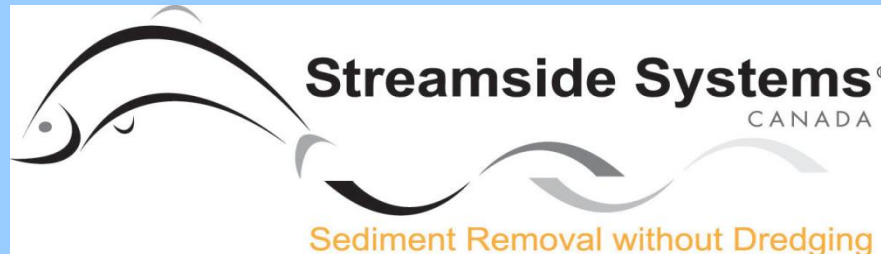


Sand and Silt Removal from Salmonid Streams



Sources of Sand and Silt

- Stream bank erosion
- Poor land use practices



Impacts of Sand and Silt

- Interstitial spaces infilled
- Little or no flow through the streambed
- Organic material from the riparian areas to support the food web lost.
- Aquatic insects habitat limited
- Fish spawning beds have no flow through them
- Instream cover is lost for fish
- Fish over-wintering habitat lost
- Watercourse over widens
 - becomes shallower and warmerIn summer leading to temperature stress
& forms thick ice in winter resulting in
stream bed and bank scouring



Current Management

- The focus of Government regulators in Nova Scotia is on prevention
- Restoration of the habitats impacted by land use are generally left to nature to “clean up” and this can take decades or often will never happen
- Construction companies often try various techniques to clean up but they are ineffective at removing the sand and silt in the stream bed which is critical to regaining aquatic productivity
- The NSLC Adopt-a-Stream Program of the NSSA is working with community groups to restore fish habitat

Current Techniques

- Instream structures to sort gravels – digger logs , deflectors, rock sills
 - Works to some extent as stream structure is restored good job at tails of pools but not very well over all
- Fire hoses to wash gravel spawning beds
 - Used in other jurisdictions
 - Tired by DFO in 1980's it works but moves sand downstream
- Vacuum trucks to remove sediment blockages
 - But does not remove sand from substrate
- No past techniques actually removed the sand from the gravel and cobble substrate and removed it from the stream

SandWand Technique

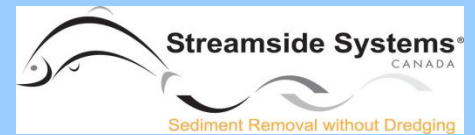
- Equipment
 - Two 2 inch trash pumps
 - Lots of intake hose
 - SandWand



The SandWand



Stainless steel
wand



The SandWand

- The SandWand system is two 2-inch trash pumps connected to a stainless steel wand that is worked by one operator.
- The operator simply rocks the SandWand back and forth on the surface.
- One pump injects water through a 1.5 inch hose to a nozzle in the wand directed into the bottom and the other pump draws off the water /sand/ silt slurry leaving gravel from 1/8 inch and larger

SandWand in Operation

- A net flow into the wand prevents turbidity in the stream
 - Wand operating in picture below



The SandWand Output

- Low turbidity water and sand is discharged into the riparian area or sand collector.
- Clean water flows back to the stream – upstream of the worksite. So no net loss of flow in the stream and turbidity monitored continuously



The SandWand

- Methodology
 - Pool and slope up to riffle crest deep cleaning
 - Riffle crest not cleaned at all to prevent low flows from seeping through drying up the stream
 - Riffle light cleaning
- Very good for cleaning sand and silt from inside coffer dams



The SandWand

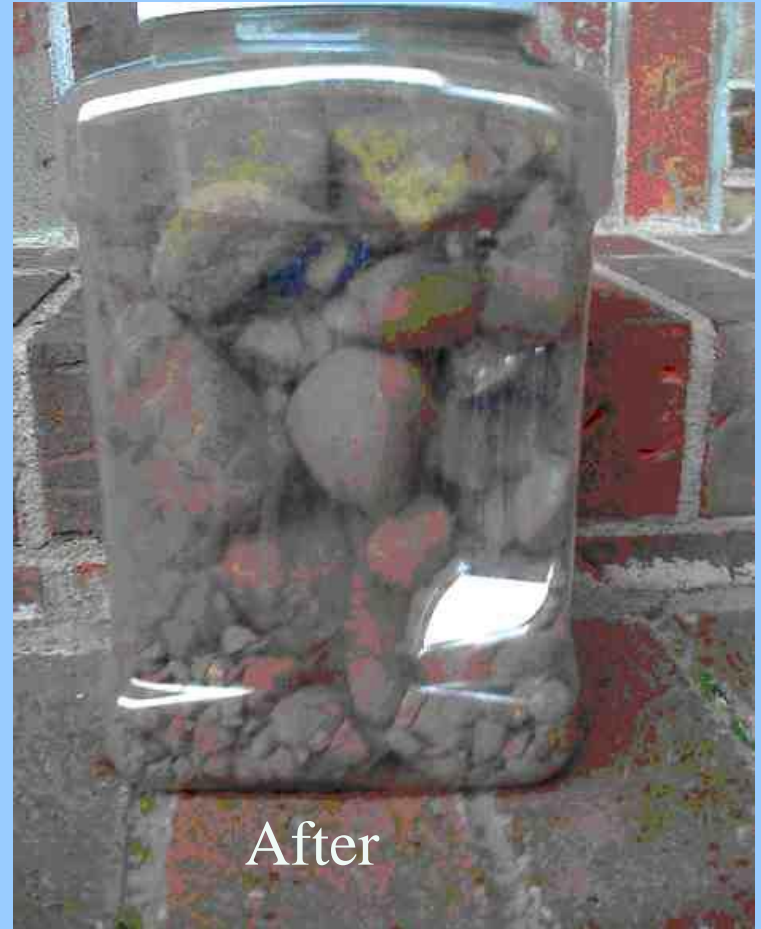
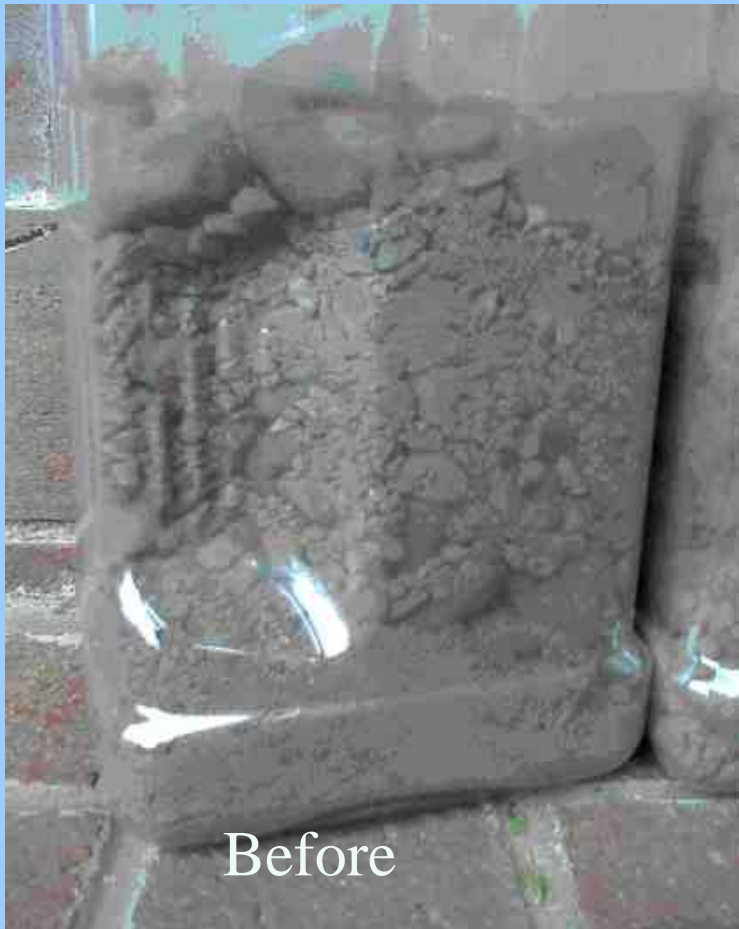


The output is clean “beach sand” with suspended solids $< 80 \text{ mg/l}$



SandWand Cleaned Gravel

15cm dia by 40cm deep core samples



SandWand Studies

- Government regulators were cautious limited approval in 2010
- Little Sackville River – 2010
 - 550 sq m cleaned at the Contessa Drive “s” turn effective but heavy sand bedload from upstream development
- Frenchman’s Brook 2010
 - Man made spawning bed in Dartmouth Crossing that was plugged with excessive algae growth in 2009 no spawning
 - Cleaned in 2010 and was widely used by trout in 2010 and 2011
- Irish Cove Brook
 - 3200 sq m above the Lakeshore Rd
 - see study results for 2010 and 2011 on following slides

SandWand Studies

Irish Cove

Before cleaning work

- Electrofished sites including all habitat types
 - density of all fish species and their lengths
- Aquatic Insect survey CABIN method.
- Physical habitat survey
 - pool size/ depth /frequency and quality
 - substrate type / screen for silt & sand vs gravel & cobble to get percent sand and silt
 - bank erosion type location and length
 - bank vegetation by type and % cover
 - width of channel and wetted width
- Photos of all sections
- Watershed area and land use types with % area

SandWand Studies

Irish Cove

During cleaning

- Assessment of materials being deposited on land (estimate of particle sizes and organic matter including invertebrates, & fish)
- Assessment of return water (turbidity, etc)
- Assessment of water in stream

Immediately following cleaning

Repeat electrofishing, insect survey, and physical habitat survey as above

Repeat each year, for 5 years, physical habitat survey each summer at the same time. The Insect and electrofishing surveys will be repeated in years 1, 3 and 5.

Results to date fall 2011

Fish

- 2010 test site
 - 58.4 trout/ 100 sq m before SandWand 83% young of the year (YOY); 17% 1year olds
 - 36.9 trout/ 100 sq m immediately after 100% YOY
 - Fish chased out of site none caught or killed
- 2011 repeat of 2010 test site
 - 100.7 trout/100 sqm 59% YOY 32% 1year olds; 7% 2 year olds
- 2011 new test site
 - 54 trout /100 sq m before 87% YOY 13% 1year olds
 - 47 trout/100 sq m immediately after SandWand 90% YOY 10% 1year old

Results to date fall 2011

Insects

- 2010 samples not properly preserved data lost
- 2011
 - 64% loss in numbers after sampling but no insects or parts found in removed sand – pump test show they survive the pump and live in turbid water – sand content may destroy them – but no parts found
 - Assessment is by kick samples and pulling the hoses through the water likely detached most of the insects that would be sampled by this method
 - population recovered after 10 days
 - continue to study

Insect Population Species

- 3 minute kick samples covering all habitat types
- species present
 - Stonefly
 - Mayfly
 - Caddis fly
 - Crane fly
 - Midges
- The ratio of each species numbers stayed the same before and after sampling.
- The 2010 site had 2.36 times the insect population of the new 2011 test site - almost all the increase as Mayflies

Results to date fall 2011

Substrate

- 40cm deep samples
- 2010 test site
 - 22% sand by weight before
 - 2.3% sand after down to 40cm deep
 - 2011 5.5% sand over all – 1% in the top 20cm and all sand in the very bottom of the sample – due to greater depth of thalweg.
Really no increase in sand in cleaned substrate
- 2011 new test site
 - 20.7% sand before
 - 2.4% sand after

Results to date fall 2011

Habitat

- 2010 test site
 - The fine gravels are brought to the surface with some remaining sand this had been sorted to the point bars by 2011
 - Habitat was shallow run with 12% third class pool now good thalweg 30% second class pool
- 2011 test site
 - Shallow run 10% third class pool
 - Established x-sections each 5m over 50m length to measure the change seen in last year's work.

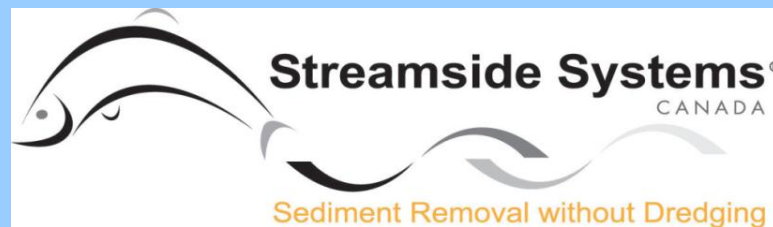
Results to date fall 2011

Temperature

- It appeared from the 2010 data that the water temperature dropped through the SandWand section. Likely due to increased ground water interchange and the increased thermal mass provided by the water flowing through the clean gravel.
- This was to be tested in 2011 but we lost the thermograph that was between the over widened section with increasing temperatures and the downstream SandWand section
- Will try to define this again next summer

Conclusion

- The technique is effective
 - Removes sand and silt down to 40cm
 - with only short term impacts on insect populations appear to fully recover within 10 days via drift
 - No adverse impact of fish populations after 24 hr
 - Indications are water temperatures are lowered and daily fluctuations stabilized
- We are looking for funding to do more sites as HADD compensation and habitat clean up
- This is currently accepted by DFO as a low impact activity and is covered under the NSE blanket permit for habitat restoration



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