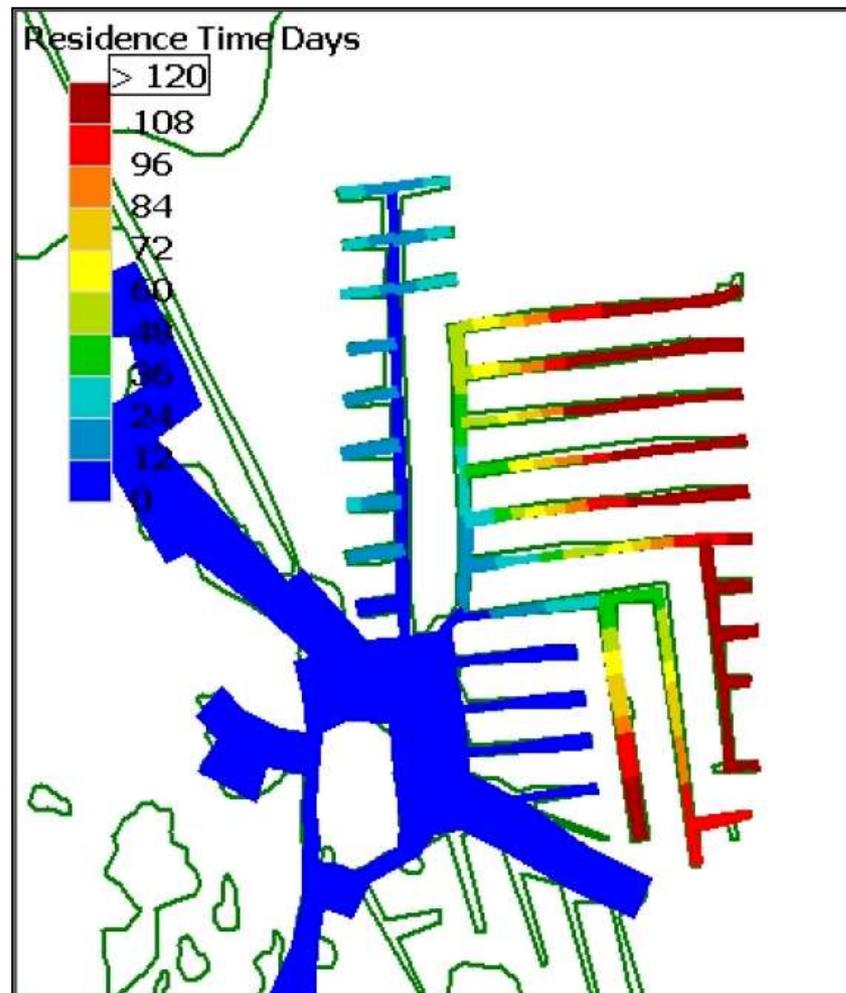


Demonstration Pilot Project To Examine Whether Diffusers Will Improve The Ecological Condition of Dead-End, Tidal Canals

Status Report, November 2013

**George Junkin, Town of South Bethany
Chairperson, Canal Water Quality Committee**

South Bethany Is Built On 5 Miles Of Poorly Flushed Dead End Canals

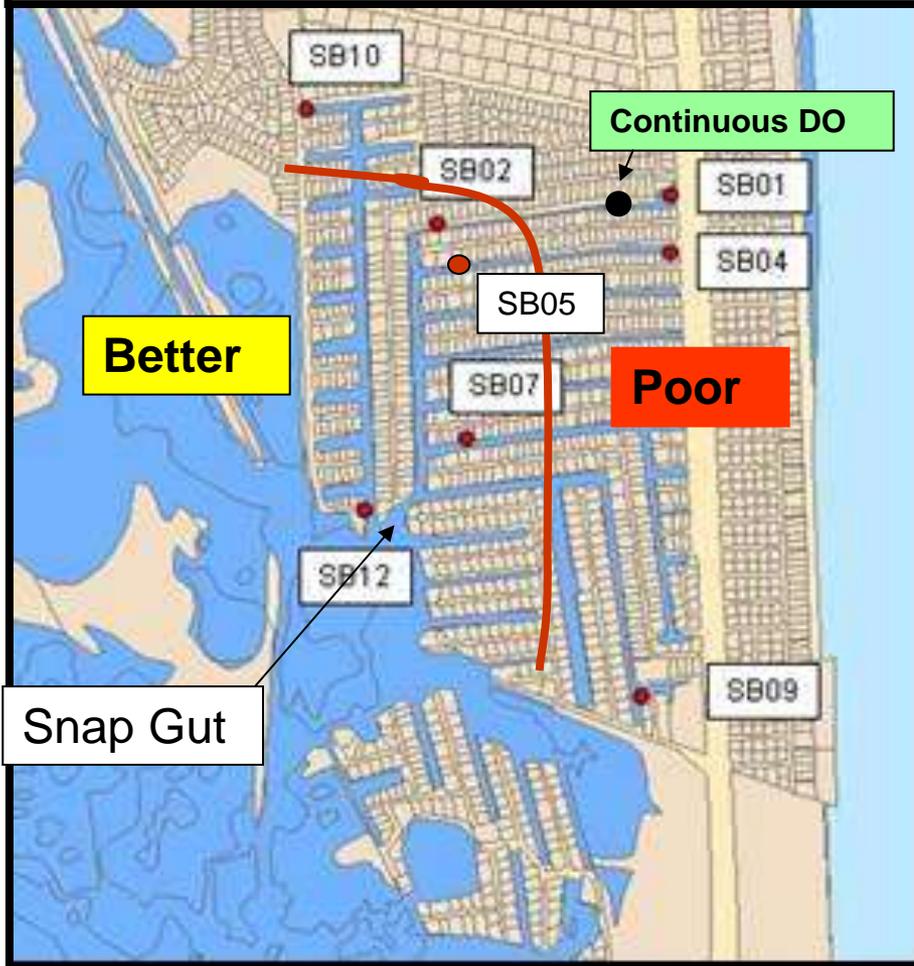


Residence times due to tidal flushing in the dead end canals is > 3 months (red area above)



Citizen Monitoring Test Results Show Increased Degradation as the Test Site Gets Closer To The Canal Dead-Ends – Consistent With The Flushing Study

Testing Locations



Quantities to be monitored:

- For “Fishable” Waters
 - Dissolved Oxygen
 - Water Temperature
 - Salinity
 - Nitrogen and Phosphorus
 - Secchi Depth
- For “Swimmable” Waters
 - Bacteria
- Storm Water Influence
 - Collect accurate local rain data

The farther removed from Snap Gut, the poorer the quality of water.

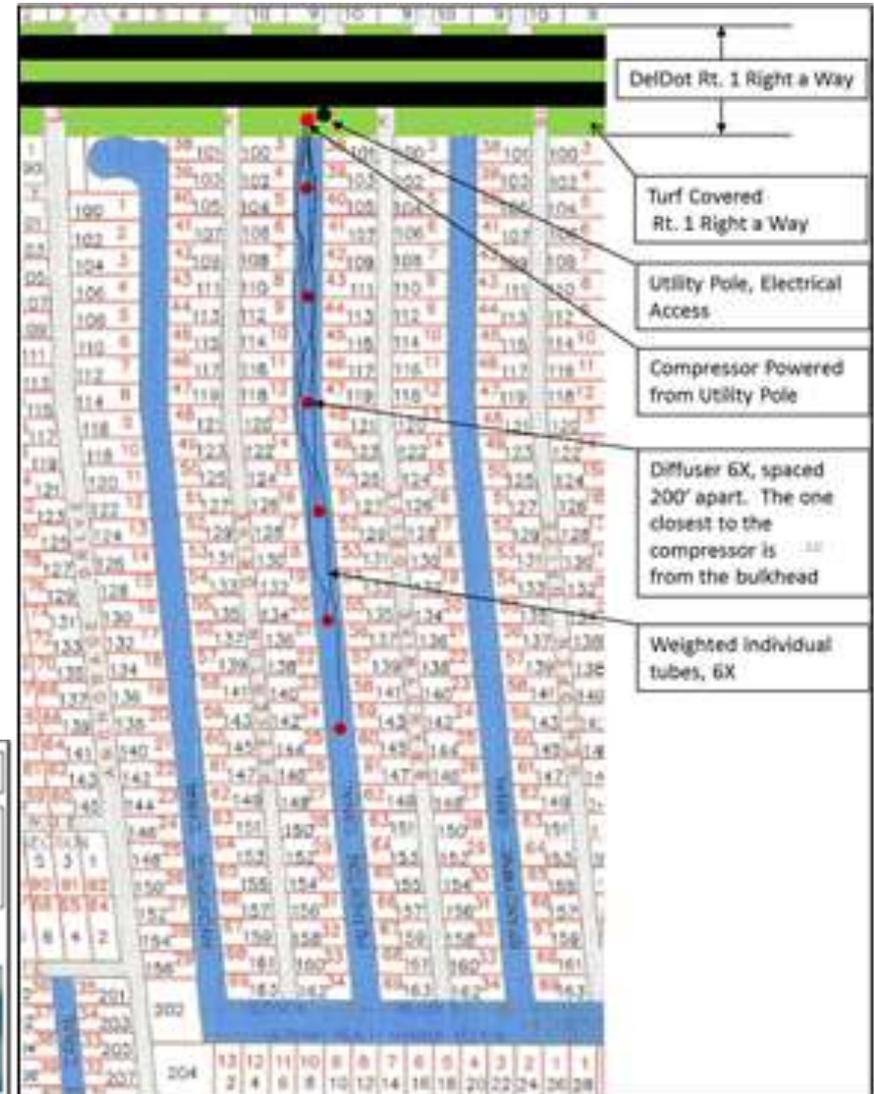
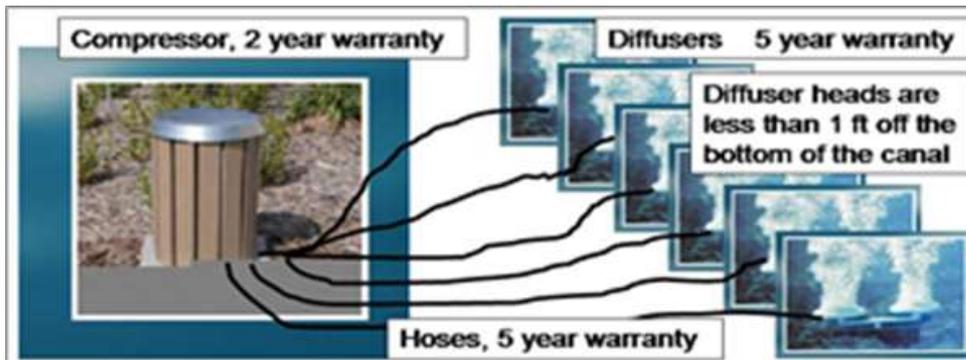


Diffusers That Are Used In Stormwater Management Ponds May Also Help In Canals

The primary objective of the two year pilot project is to determine if diffusers will provide a new method that works effectively in dead-end tidal canals, as they do in stagnant water management ponds, to increase dissolved oxygen and possibly reduce algae blooms.

Three canals are being used in the study;

- Anchorage
- Petherton (Has 6 diffusers installed)
- Brandywine (this is the control canal)



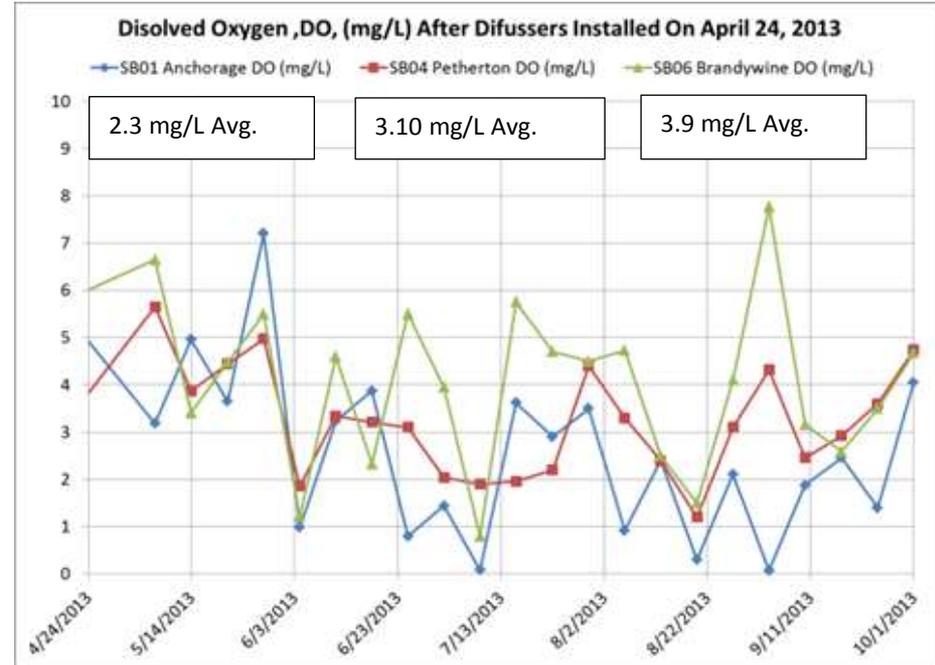
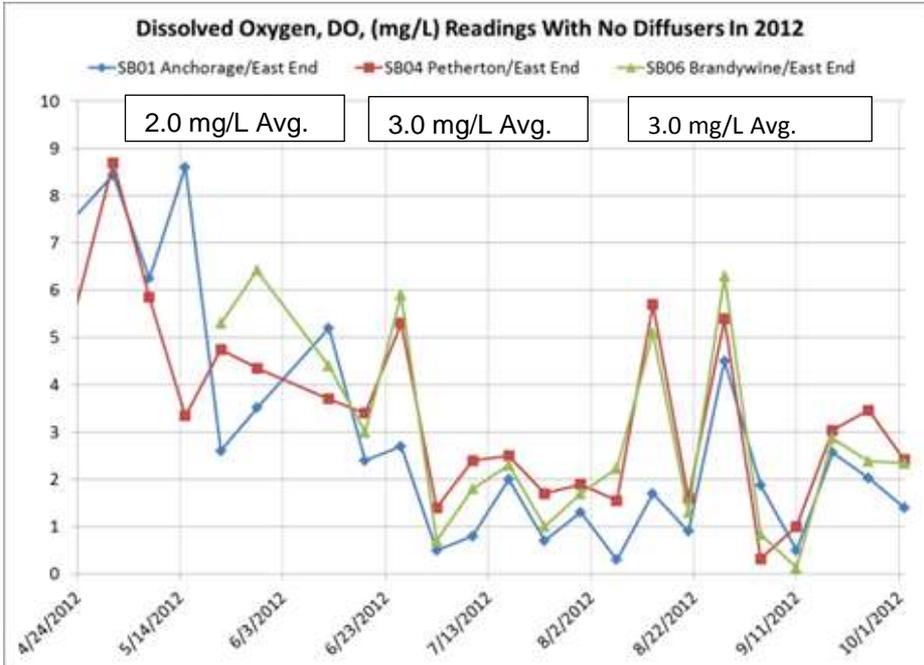


Diffusers Were Installed For The Town Of South Bethany By Envirotech On 4/24/13





Results From Monitoring From Shore At Canal Ends For The Period 5/21 to 10/1 (2012 & 2013)



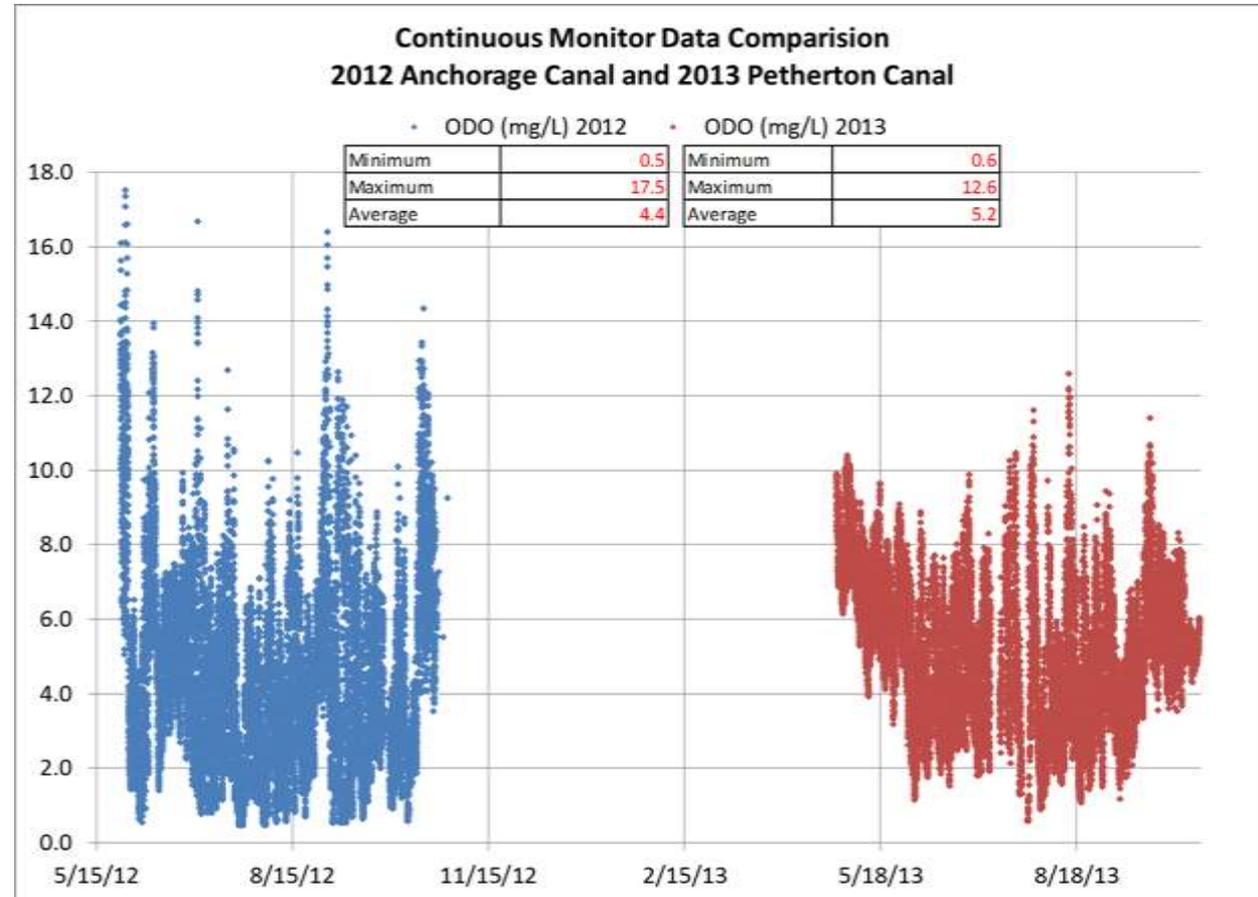
- The 2012 chart shows that Petherton followed the large fluctuations in DO (~0.0 to ~6.0 mg/L) that were seen in the Brandywine. Both the Petherton and the Brandywine had the same average DO level of 3.0 mg/L.
- The 2013 chart shows that after diffusers were installed the fluctuations in DO in the Petherton were now reduced to ~1.0 to ~5.0 mg/L. In the canals that did not have diffusers the fluctuations ranged from ~0.0 to ~8.0 mg/L. Average DO was higher in 2013.



Results from the continuous monitor 2012 In The Anchorage – 2013 In The Petherton

As can be seen from the charts above

- There was less fluctuation in DO in the canal that had the diffusers.
- The low DO measurements in the canal with diffusers were slightly higher.
- The highs were significantly lower in the canal with diffusers.
- The average was 0.8 mg/L higher in the canal with diffusers.

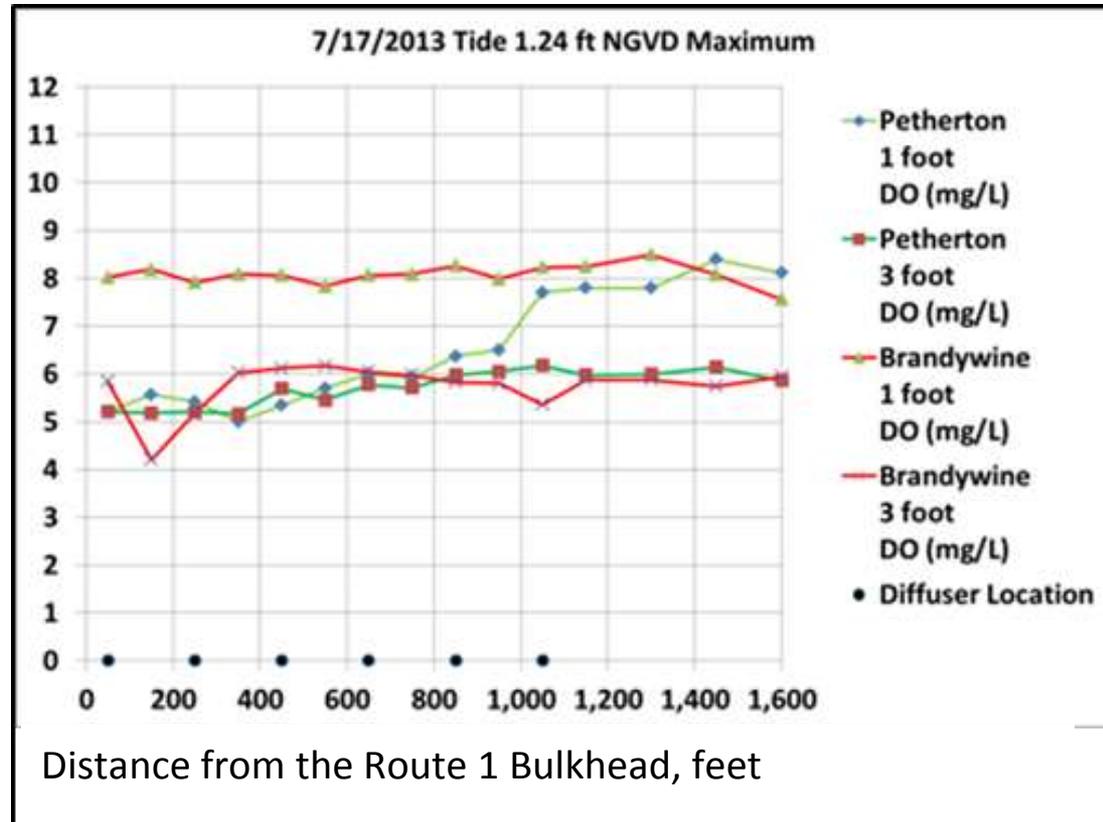




Results From Weekly Monitoring By Boat

Below Are Data From One Of 17 Weekly Trips

- At 1200 to 1600 ft., no diffusers, there is about 2.0 mg/L difference in DO between the one foot reading and the three foot reading.
- In the Brandywine (red curves) the 2.0 mg/L difference in DO between the one foot reading and the three foot reading extends all the way back to 50 feet from the Rout 1 bulkhead.
- In the Petherton (green Curves) the difference in readings between the one and three foot readings are eliminated.
- The surprising result is that where there are diffusers in the Petherton the average DO is lower than in the Brandywine by about 2.0mg/L.



Why are the diffusers sucking oxygen out of the Petherton Canal?



Why Are The Diffusers Sucking Oxygen Out Of The Petherton Canal?

- The reduction in DO level where the diffusers are located does not make intuitive sense. The diffusers are adding oxygen, but where is it going. One explanation is, since diffusers are used to reduce “muck” on the bottom in ponds, that the diffusers are stirring up the zero DO components on the bottom and that it is stimulating the aerobic digestion process thus reducing nutrient levels and, possibly, associated algal growth. Raising the DO level near the bottom would favor aerobic bacterial decay of organic matter, “muck,” which is faster than anaerobic decay. So adding the oxygen via diffusers should reduce the muck over time.
- A second explanation for the apparent reduction in DO levels is that if canals are 4 to 5 feet deep, sampling at 1 foot and 3 feet covers only 60 to 75% of the depth profile, so it’s conceivable that if Petherton Canal is well mixed, the DO level nearer bottom might be similar to that at other depths, whereas Brandywine Canal might have had very low DO levels near the bottom that are not seen in the 3 foot and 1 foot sampling. Thus it would appear that the average DO level in the Petherton Canal is lower than in the Brandywine Canal. Since we try not to foul the probe on the bottom, we do not know the actual bottom reading.



Summary - Conclusions

- The diffusers do eliminate stratification. (If there had been diffusers in the Russell Canal ends, the fish kill that occurred around September 9/10, 2013 probably would not have occurred.)
- Thus far the diffusers have not appeared to increase the DO level in the Petherton Canal. In reality they appear to have caused the DO to be reduced.
- The apparent reduction in DO level where the diffusers are located does not make intuitive sense. The diffusers are adding oxygen, but where is it going. One explanation is that the oxygen is being used to reduce “muck” on the bottom.
- Because of this “muck” reduction issue, some “muck” depth measurements were attempted. More muck depth measurements will be made for comparison next year.
- Time will tell. That is why the project is scheduled for two years.