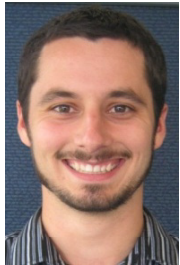


Carbon Credits

Cross-functional TPM Team



Richard



Tim



Allan



Warren



Gary



Rachel



Tony

A joint venture company of



Mackay
Sugar

CHELSEA CARBON PLANT

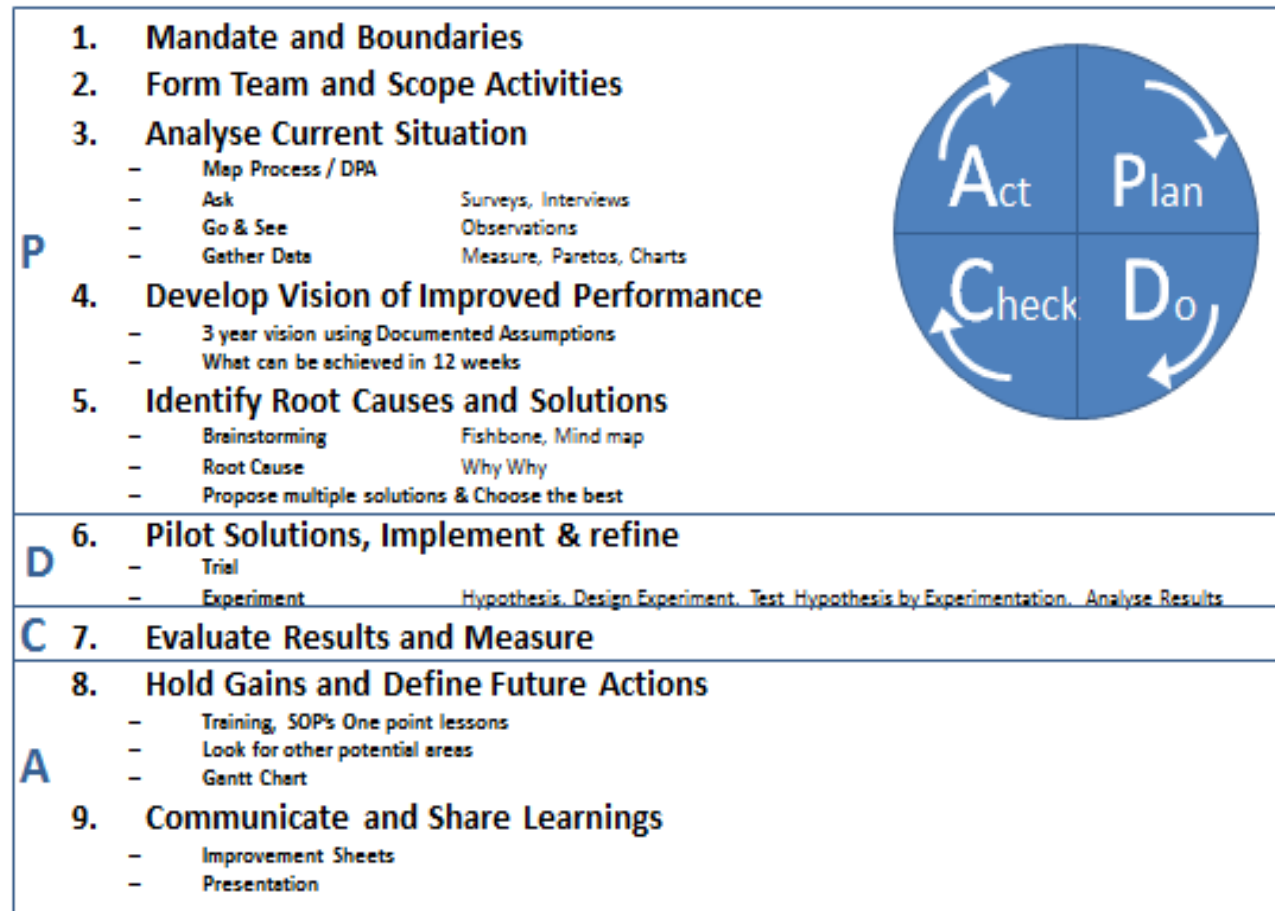


WASTEWATER TANK

Approach Taken

PDCA (Plan-Do-Check-Act)

Typical 9 Step TPM Process



Mandate & Boundaries

Mandate

The Carbon Plant Trade Waste Team Mandate

- For the carbon plant reduce the trade waste output by 50%;
- Improve or Maintain the Business Goal Aligned Performance Measures in a Sustainable manner;
- Recommend and prioritise further improvement opportunities to further reduce to the Leadership Team;
- Complete within 12 weeks after kick- off



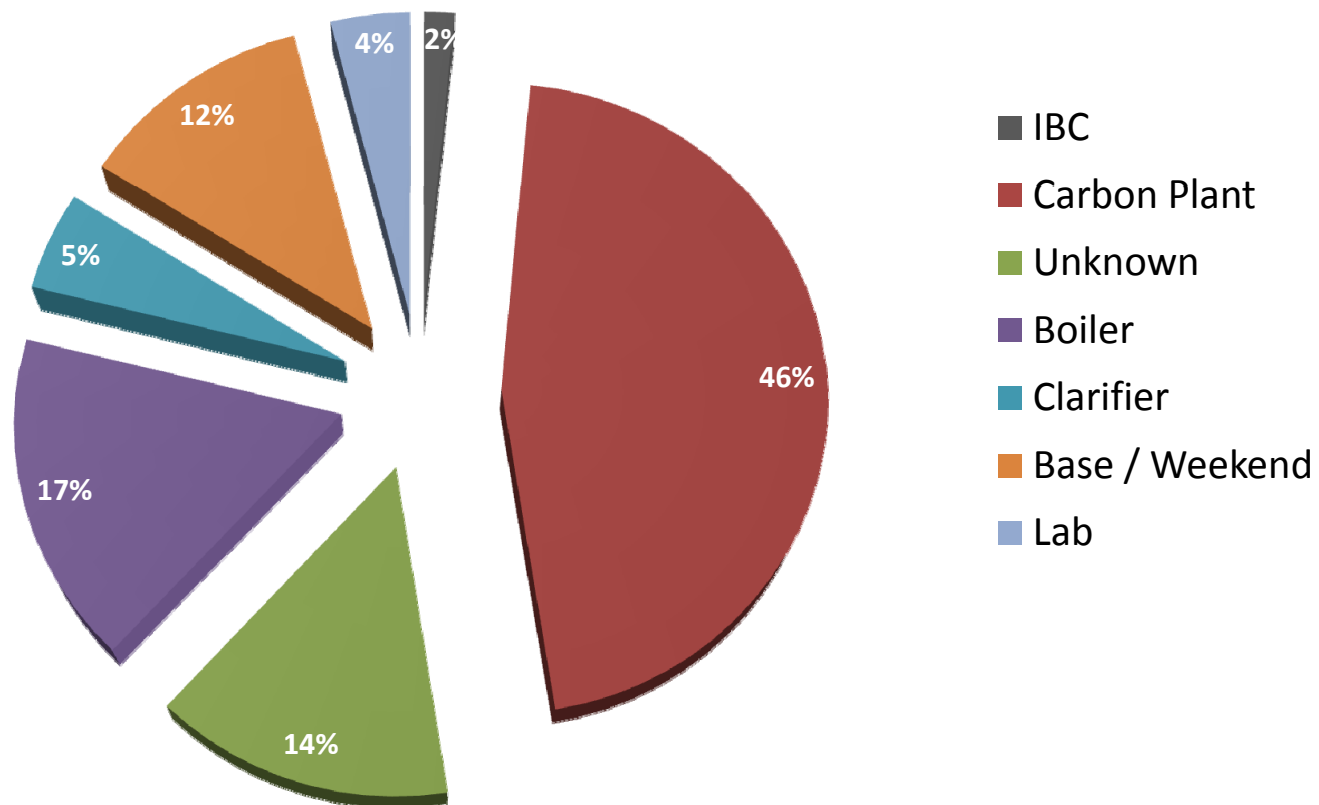
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Analysis Conducted

Baseline Analysis Sources of Trade Waste Flows

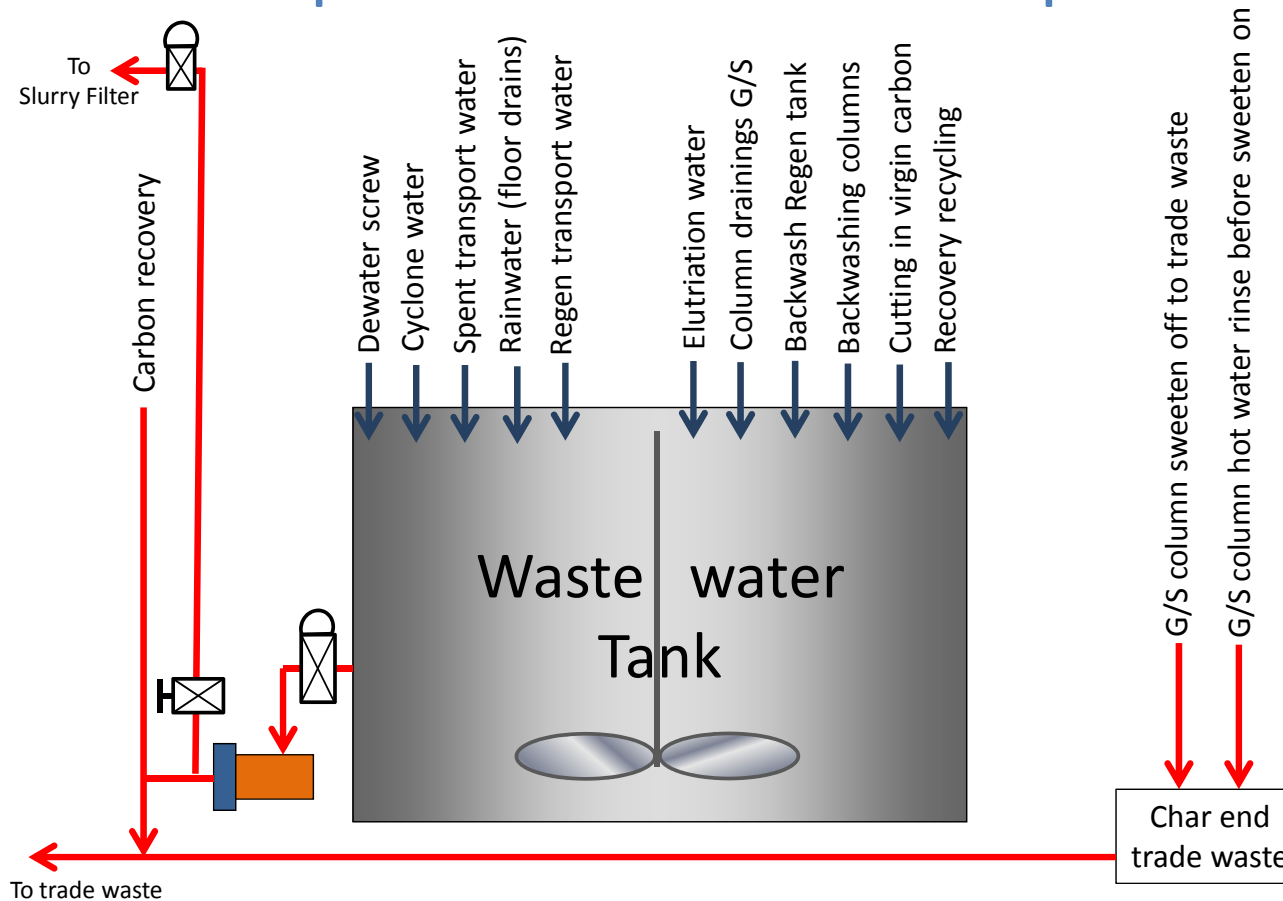
Trade Waste Sources



Analysis Conducted

Process Flows

Carbon plant – waste water inputs

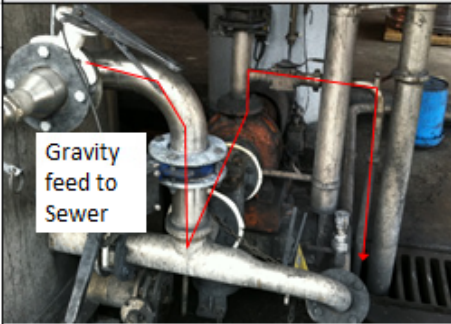
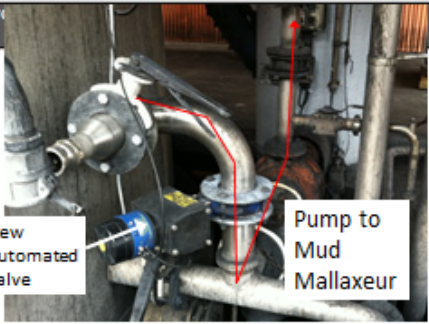


Analysis Conducted

Determine Baselines

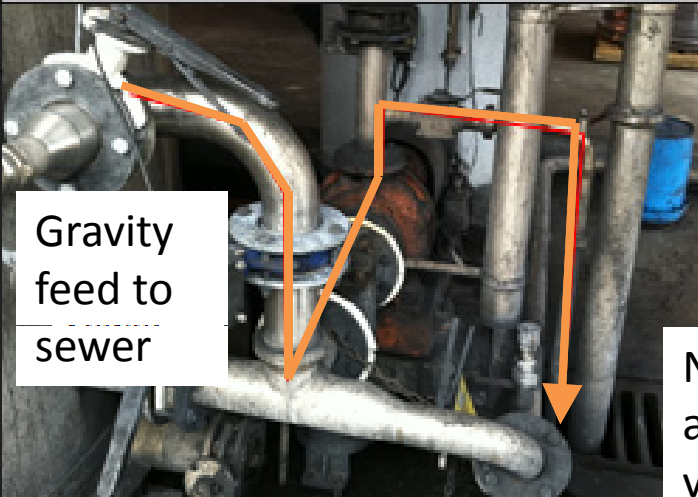
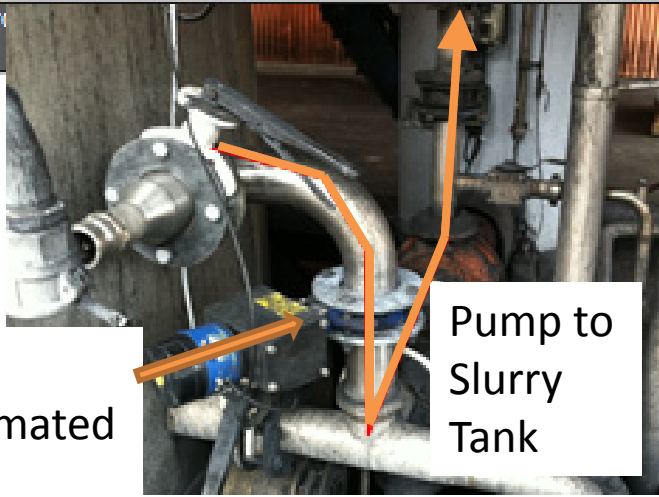
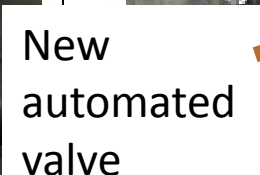
HOW TO MEASURE TRADEWASTE FROM CARBON PLANT?

- Waste water normally flowed from Waste Tank via gravity.
- If we always use the Pump to discharge it, we can record Pump Hours.
- Automated Valve ensures no flow when pump off.
- Set up Control System based on tank levels
- Measured Pump Flow rate.
- PLC Code multiplies Flow x time & records KL
- Auto Saves previous weeks result.

TPM ³ Improvement Sheet				
Team Name:	Carbon Credits	Location:	Carbon plant Waste Water Tank	Initiated Date:
Team Type:		Item:		Completed Date:
Initiator:				
1. Problem				(Plan)
Waste water flowing directly to trade waste				
				
		Cost:	Expected Saving:	
4. Results (Check)				
5. Future Actions (Act)				
Approved by:	Shift A	Shift B	Shift C	

Tangible Achievements

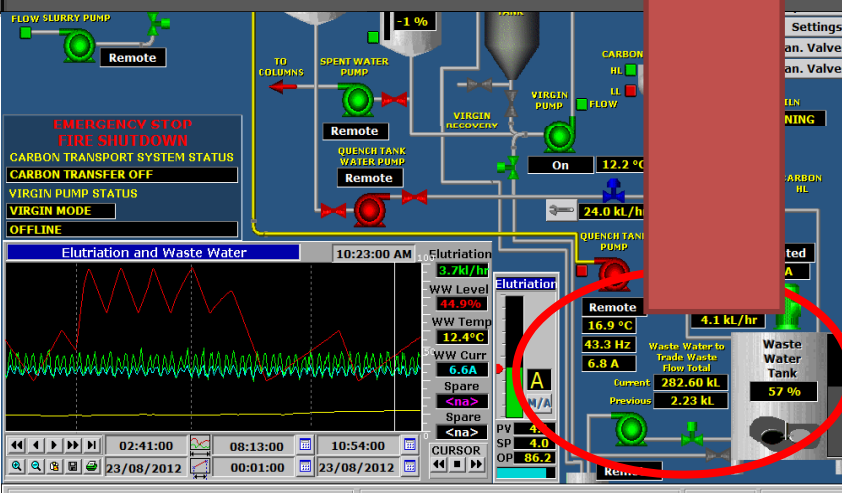
Improvement Sheets

TPM ³ Improvement Sheet					
Team Name:	Carbon Credits	Location:	Carbon plant Waste Water Tank	Initiated Date:	
Team Type:		Item:		Completed Date:	
Initiator:					
1. Problem					(Plan)
Wastewater flows directly to trade waste			Wastewater now recovered		
 <p>Gravity feed to sewer</p>		 <p>Pump to Slurry Tank</p>		 <p>New automated valve</p>	
		3. Pro			
		Cost:		Expected Saving:	
4. Results (Check)					
5. Future Actions (Act)					
Approved by:	Shift A	Shift B	Shift C		



Tangible Achievements

Improvement Sheets

TPM ³ Improvement Sheet				
Team Name:	Carbon Credits	Location:	Carbon plant Waste Water Tank	
Team Type:		Item:		
Initiator:				
1. Problem				
Cannot control or measure baseline of waste water to Trade Waste				
2. Current Situation (Plan)		3. Proposed Change / Approved Improvement		
No Method of measuring, analysing or controlling amount of waste water flowing to sewer from the Carbon Plant				
		Cost:	Expected Saving:	
4. Results (Check)				
5. Future Actions (Act)				
Approved by:	Shift A	Shift B	Shift C	

New pump set up showing automatic valve, pump & the 2 boxes with CURRENT and PREVIOUS weeks Data in them. The data is also trended so it can't be lost.

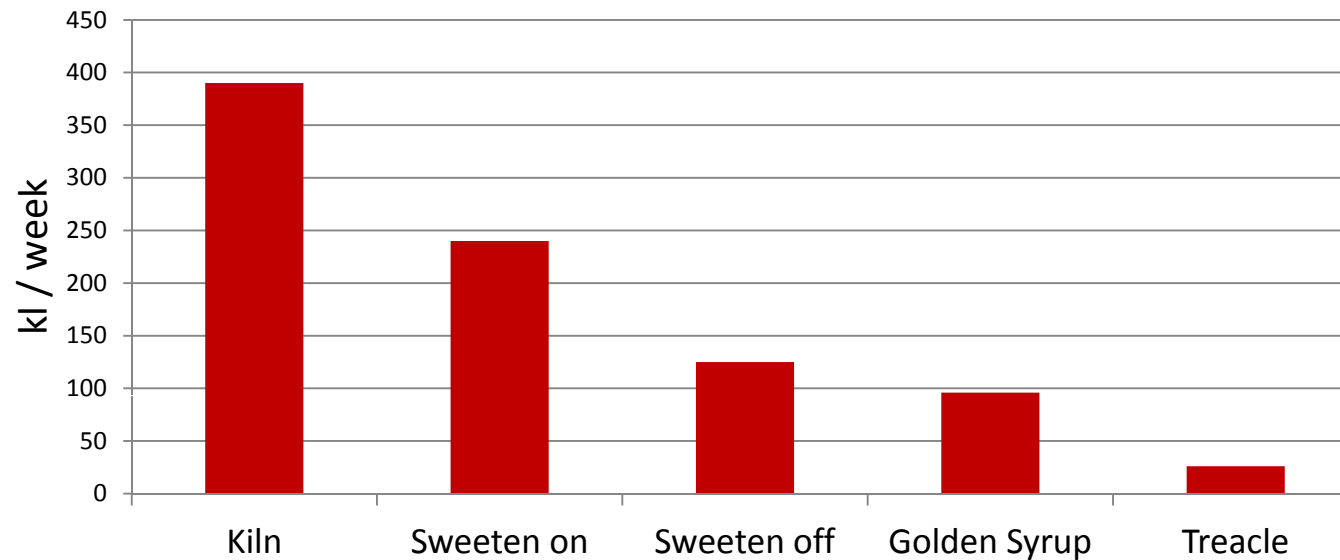
Improvement Tools used

Paretos

Water IN

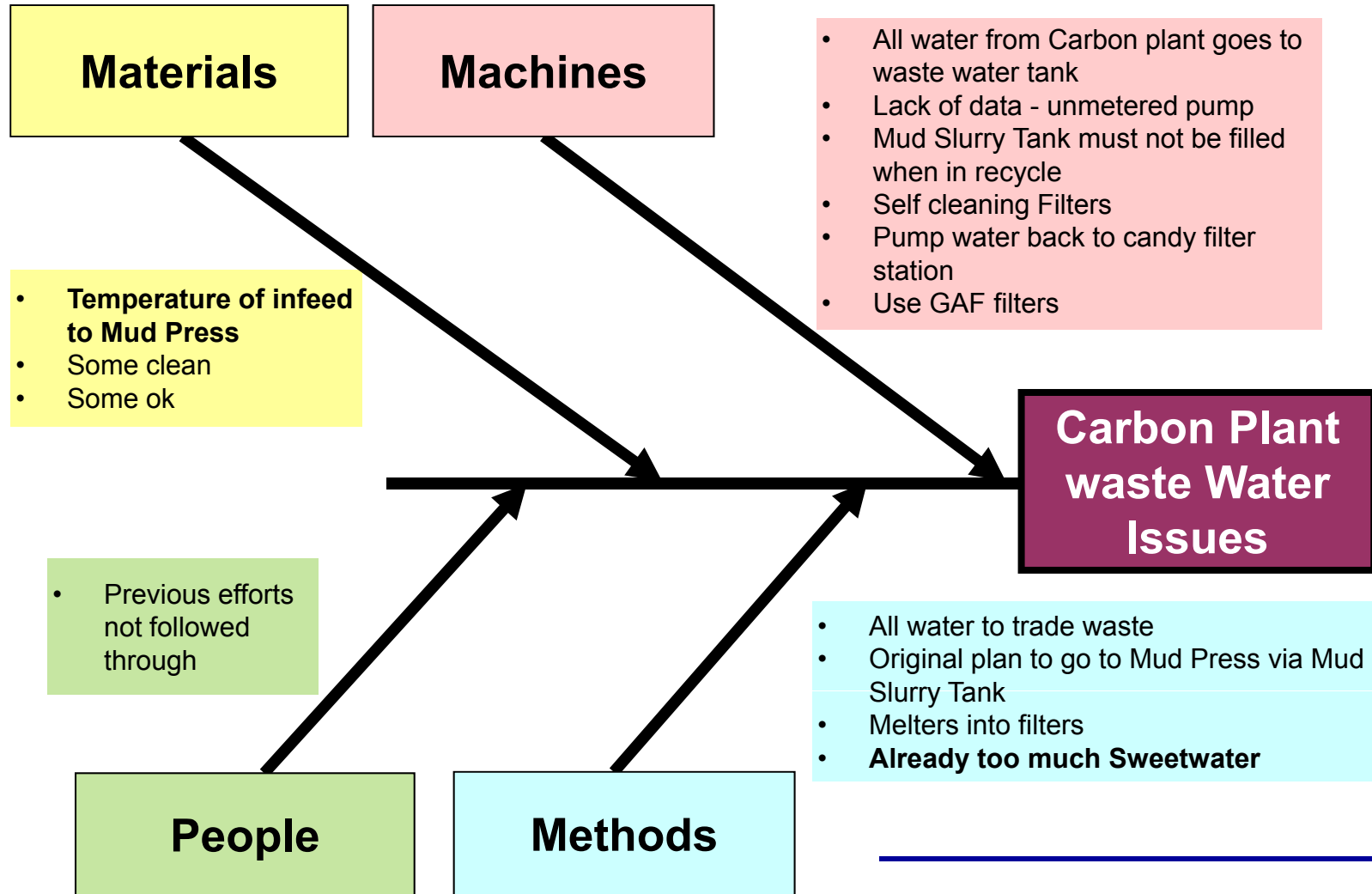
- Total 580 kl water in per week (average) @ \$1.20 per KL =\$34800/year
- Top up from hot water tank (est 55kl/week)

Water OUT



Improvement Tools used

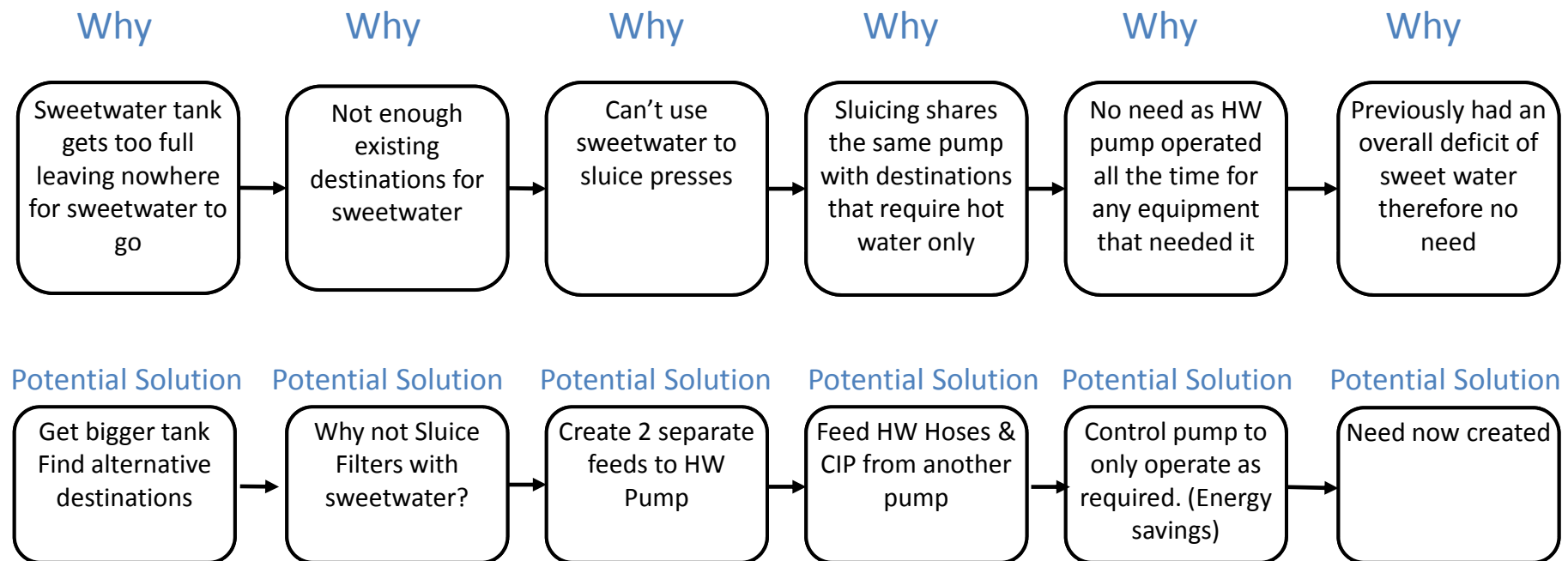
Cause and Effect Diagram



Improvement Tools used

Why-Why Analysis

Limitations on sending carbon waste water into Sweetwater System

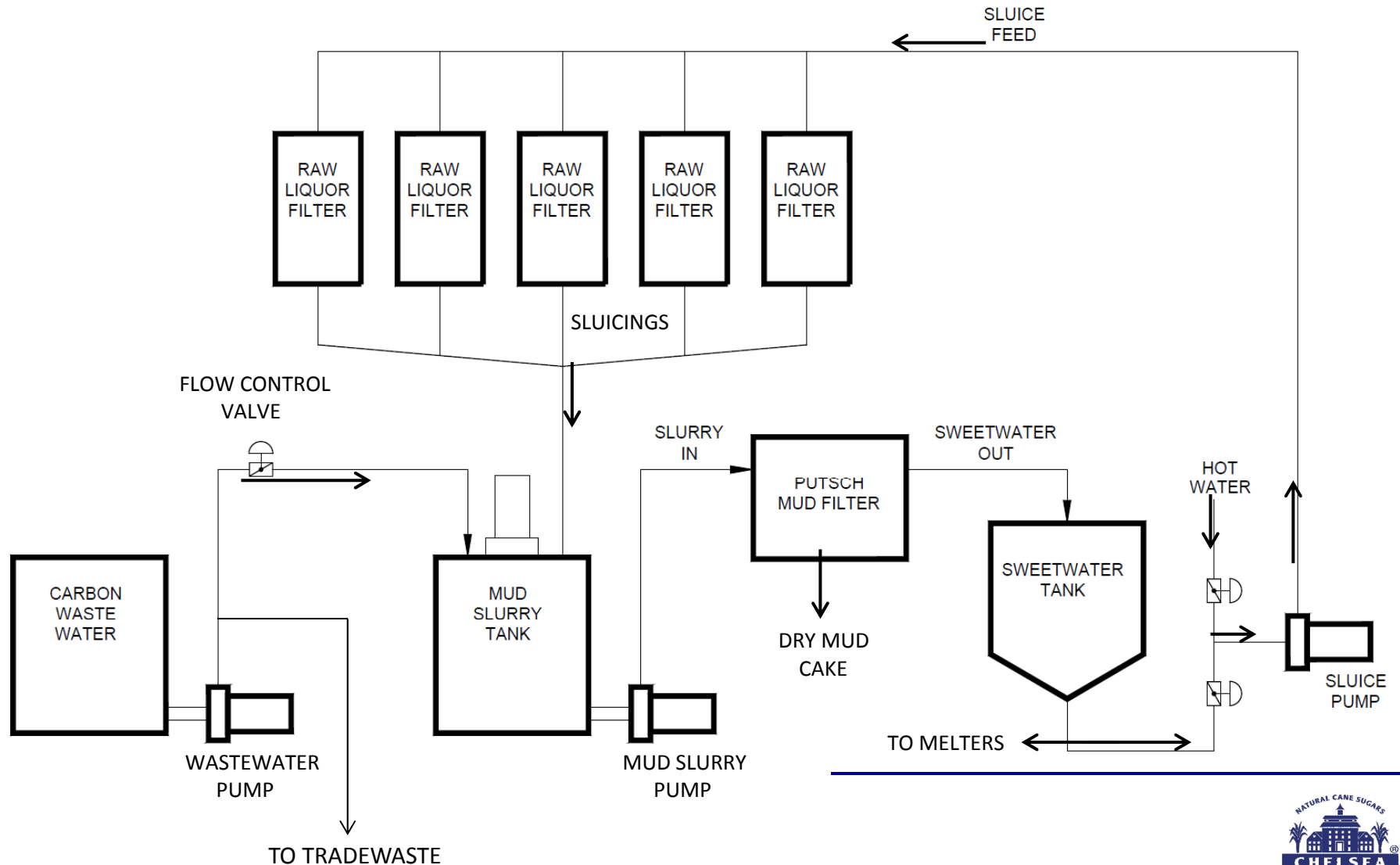


HW = Hot Water

Sweetwater = water with a low concentration of sugar dissolved in it



CARBON WASTEWATER FLOW DIAGRAM



Improvement Tools used

Trials & Experiments

Trial Waste Water Recovery. Date 6th September.

- Method: Pumping Carbon water to Mud Slurry Tank when the Mud Filter running in "Filtering" state.
- Flow Rate: Control valve set 30% open = 1.5 kl/hr
At this rate we would only recover about 80 kilolitres max per week.
- Effect on Putsch Mud Slurry Filter:
 - Putsch Feed temp before = 69°C.
 - Feed temp during trial = 68°C.
 - Flow rate and volume through the filter not noticeably affected.

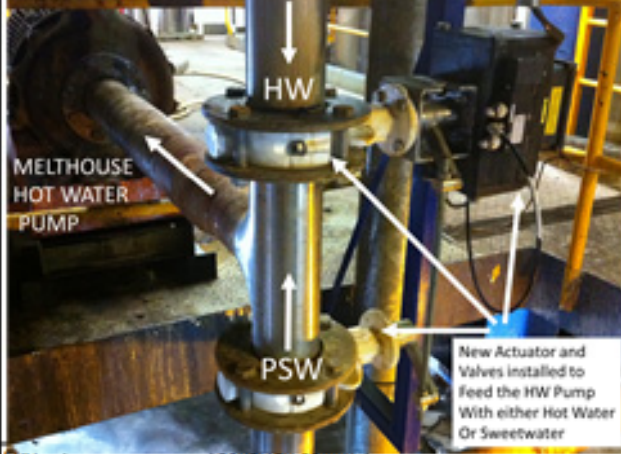


CARBON WASTEWATER TO SLURRY TANK TRIAL #2 FEED VALVE 50% WJ.

0935	TEMP	PUTSCH stop recycle. Start pumping to Mallax
0940	66	
0945	62	
0950	62	
0955	68	
1000	65	Mallax level dropping
1002	65	PUTSCH start Recycle. Mallax low. Stop pumping to Mallax
1005	60	
1010	59	
1015	60	PUTSCH stop Recycle Mallax filling. Start pumping to Mallax.
1020	65	
1025	65	Mallax level dropping
1030	60	PUTSCH Start Recycle. Mallax low. Stop pumping to Mallax
1035	58	
1040	57	
1045	60	PUTSCH Stop Recycle. Mallax Filling. Start Pumping to Mallax.
1050	67	
1055	65	Mallax level dropping
1100	61	PUTSCH Start Recycle. Mallax low. Stop Pumping to Mallax.
1105	60	
1110	60	
1115	60	PUTSCH Stop Recycle. Mallax Filling. Start Pumping to Mallax.
TRIAL ENDS. PUTSCH FULL OF MUD & COMMENCES COMPRESSION & DESWEETEN SEQUENCE.		

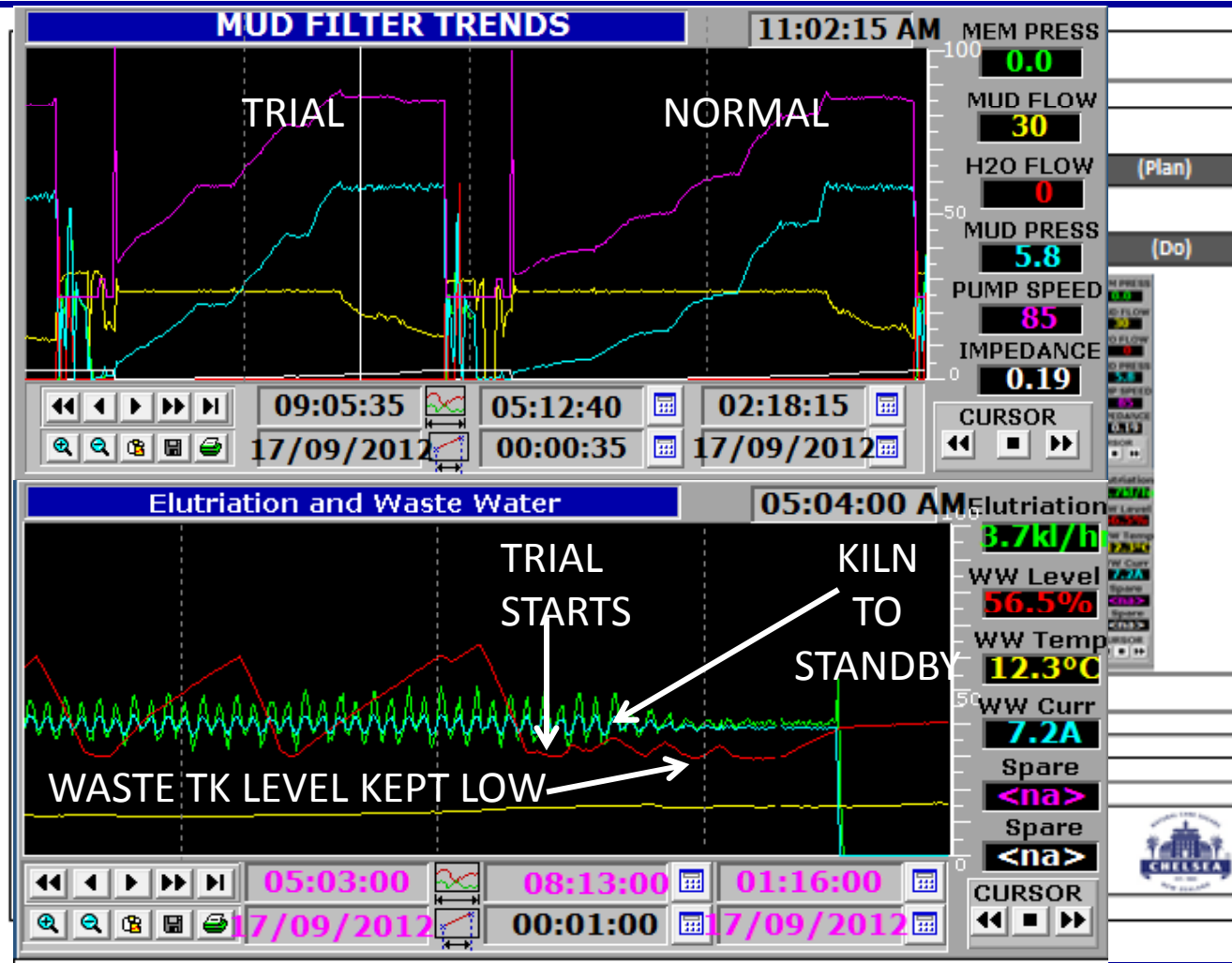
Tangible Achievements

Improvement Sheets

TPM ³ Improvement Sheet				
Team Name:	Carbon Credits	Location:	Hot water Pipes	Initiated Date:
Team Type:		Item:		Completed Date:
Initiator:				
1. Problem				(Plan)
ADDING SWEETWATER SUPPLY TO SLUICE PUMP				
2. Current Situation		(Plan)	3. Proposed Change / Approved Improvement (Do)	
<p>ORIGINALLY THE SLUICE PUMP WAS ONLY FED WITH HOT WATER.</p> <p>WE ADDED THE SWEETWATER OPTION TO IT.</p>				
4. Results (Check)				
5. Future Actions (Act)				
Approved by:	Shift A	Shift B	Shift C	

Tangible Achievements

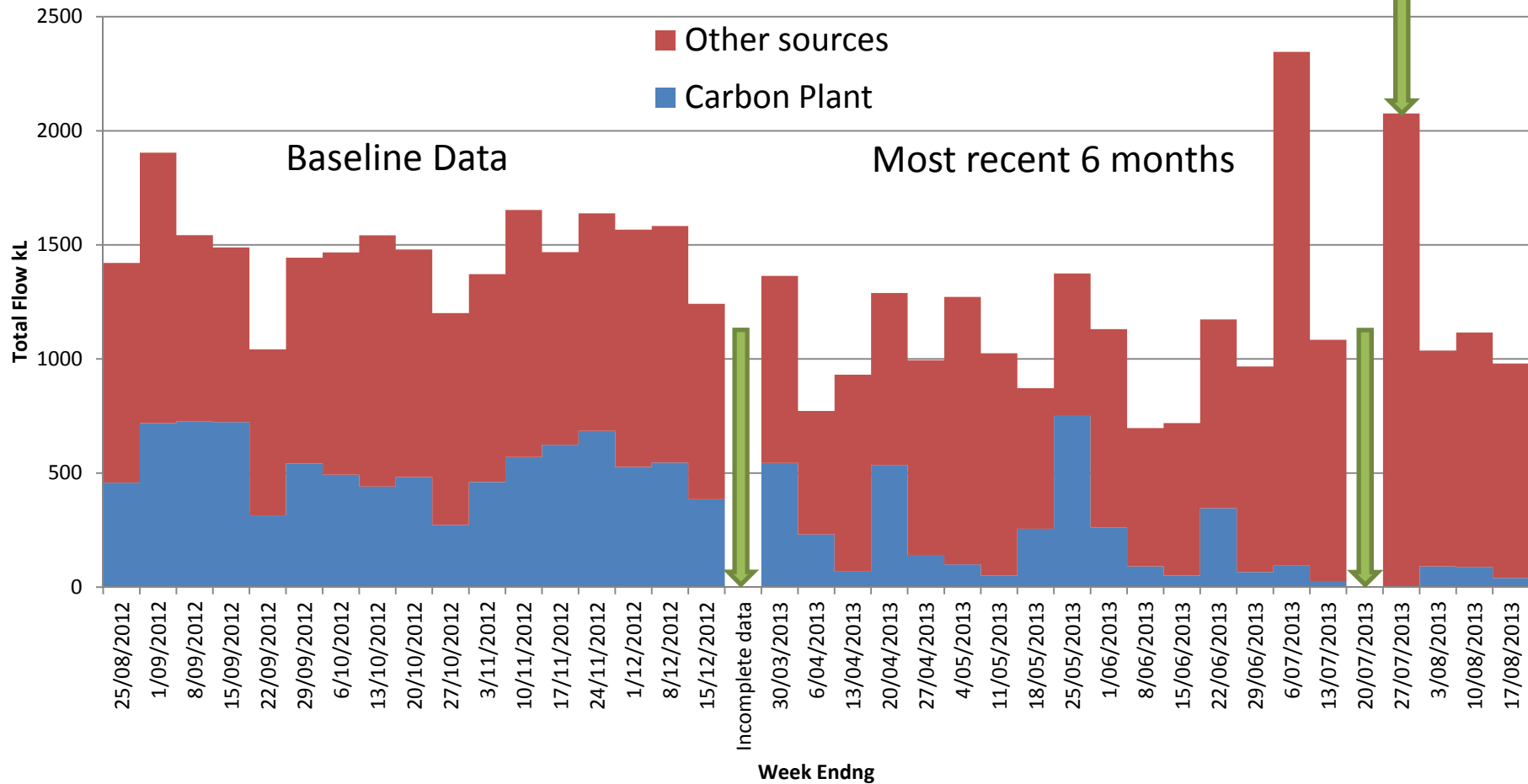
Improvement Sheets



Tangible Achievements

Achieved Mandate

Graph Showing Historical Trade Waste Data by Week



Tangible Achievements

Cost Reductions

Edit ORANGE cells to view cost/savings values

Steam Cost			Hot Water Saving		
TW cost	2.03	\$/kl	Bulk water cost	1.2	\$/kl
Flow Rate to Putsch (CCWW)	3.5	kl/h	Flow reduction to SW	3.5	kl/h
T Final (CCWW)	70	°C	T final	80	°C
T Start (CCWW)	30	°C	T start	20	°C
hours	24		hours	24	
days	4		days	4	
weeks	50		weeks	50	
Flow to Putsch	336	kl/w	Flow saved from HW	336	kl/w
Steam Cost to heat CCWW	\$35,256		Hot water saving	\$41,381	
MJ/t melt extra	19		Energy saving/t	21	
MJ/t	2,270		MJ/t before saving	2,273	
			Water reduction savings	403	\$/w
Total energy cost/savings			Saving		
			Per Annum		
Total cost/savings MJ/t			Saving		
			Per Annum		
Total water reduction savings			Saving		
			Per Annum		
TW savings			Saving		
			Per Annum		
Total Savings			Per Annum		



Tangible Achievements

Sustained Impact – Locking in the Gains

Further Changes to allow Almost 100% of carbon waste water to be recovered

Debugging, commissioning work to perfect the system

- More accurate calibration of recovered water flows to Mud Slurry Tank
- Replace steam heating pipe to Mud Slurry Tank
- New Golden Syrup filter automation to be added to Hot Water Pump users logic

Much of this has now been completed. This has led to

- Recovering ~90% of the Carbon Waste Water when running
- Equates to ~65% overall when taking into account the time the system does not operate.
- ~21% reduction in total site wide trade waste reduction.



Tangible Achievements

Impact on Goal Aligned Measures

Approximate Annual Savings

- Reduced Trade Waste flow \$34,104
- Reduced supply water usage \$20,106
- Saved energy from steam heating \$6,125

- Total Savings from this TPM team \$60,389 per annum

- The original mandate of 50% reduction in the amount of trade waste from the Carbon Plant was seen as a stretch goal for this team, but the Team discovered it was possible to reduce the Carbon Wastewater flow to very close to zero!



Intangible Achievements

Additional Benefits

- Using Sweetwater Sluicing for the filters.
 - Carbon Column turnover was sometimes delayed due to the Sweetwater tank being full
 - Now the tank never gets too full, the Carbon Columns are no longer delayed
 - Improved efficiency of this part of the operation
- Environmental Impact reduced
 - less water being used (and disposed of)
 - less risk of an event which could lead to discharges of carbon into the trade waste or the wider environment
 - The old system had inherent risks of accidental discharge, but the new system is much more Robust.
- All those on this Team and also the wider Operations Team have learned much more about the way this part of the refinery works.
 - As a result better decisions are able to be made in the future.



Communication

Lessons Learnt

- **Roadblocks** getting programming resources from Control and Automation.
 - Leadership Team listened and increased the priority on these changes.
- **Progressive achievements** showed that the team was making progress along the way.
- The team discovered many new things, such as:
 - The Putsch Filter performance is affected by Feed Temperature.
 - The Hot Water line from the main Hot Water Pump went to many different places, many of which will be in trouble if they got sweetwater,(ie Tank CIP Manifolds & washdown hoses)
- **Mindsets.** Reasons for dismissing things in the past may no longer be valid.



Communication

Detailed communication at each stage to all involved. This included:

- Operators
 - Word of mouth - Verbal regarding upcoming trials
 - Whiteboard in Melthouse Control room
 - Information sheets
- Wider organisation
 - Leadership team updates
 - Midway Presentation and the Final Presentation.



INTER OFFICE MEMO

To:	MH OPERATORS & SHIFT TEAM LEADERS
From:	WARREN
Date:	6/08/2013
Subject:	WASTEWATER FLOW FROM CARBON PLANT

Hi Guys

The "CARBON CREDITS" TPM team is working on reducing the flows to Trade Waste from the Carbon Plant. We need to establish an accurate BASELINE flow first of all before beginning to reduce it.

To accurately measure the total kl of water going down the sewer from the Wastewater tank each week, we have decided to use the Wastewater Pump as our measuring element. We are going to pump all of the water going down the sewer with the Wastewater Pump by having it turn on when the tank fills to preset High level and stopping it at a preset Low level.

The Citect will record the hours that the Pump runs each week and multiply by the Pump Flowrate (24 kl/hr) and display this for us & reset the counter at midnite on Sat nights.

To prevent water flowing through the Pump when it is not running, we are fitting an Actuator to the Valve from the Tank. At HL the valve will open, then the pump starts, and at LL the Pump stops & the Valve closes. New Valve will display on Citect screen. For this to work the Pump should be left in REMOTE all the time.

Thanks in advance for your co-operation.
Warren.

Summary

- Mandated to reduce Carbon Plant Tradewaste by 50%.
- Invented a way to measure it.
- We reduced it by about 90%.
- Discovered we needed Sweetwater Sluicing to realise the full potential savings so we experimented & got that working.
- Reduced delays to Carbon Column turnover in the process.
- Reduced Borough water consumed in the process. Reduced Costs.
- Reduced Environmental impact.

