Hysham Notes for 2/23/2023

(Plan in black / Notes in red)

Our plan for Wednesday 3/1/2023 is to discuss the PLC and control system upgrade with Great West Engineering and a representative from In Control. Boreal Controls sent me a copy of the PLC program. I have forwarded this to In Control to make a PDF copy that we can use to understand what the controller is supposed to do and how it needs to be improved.

Reduced adsorption clarifier cycle time from 600 to 300 minutes. We reduced the cycle time from 1200 to 600 minutes last week. The liquid leaving the clarifier was still very dark after a flush cycle and appeared to cause the filter turbidity to spike to 0.4 NTU. The control system was effective at diverting the filtered water to waste. We flushed the clarifier 2 times. We observed beads on top of the clarifier similar to last week.

Opened the air vent valve from the diversion flapper solenoid a little. The valve is being pinched to conserve air and prevent excessive compressor operation due to a leak in the solenoid or pneumatic piston. If the vent is pinched too much, there is too little air for the flapper to cycle reliably. Repairing the cylinder and solenoid has been added to our to-do list / plan document.

Changed the clear well effluent turbidity sensor name from FILTER2 to POE NTU.

Attempted to adjust the chlorine logging frequency to 10 minute average values, but it wasn't clear that this could be done. The manual discussed building calculations which we tried, but it appears the instrument measures every 2.5 minutes and records each value. We left it as it was.

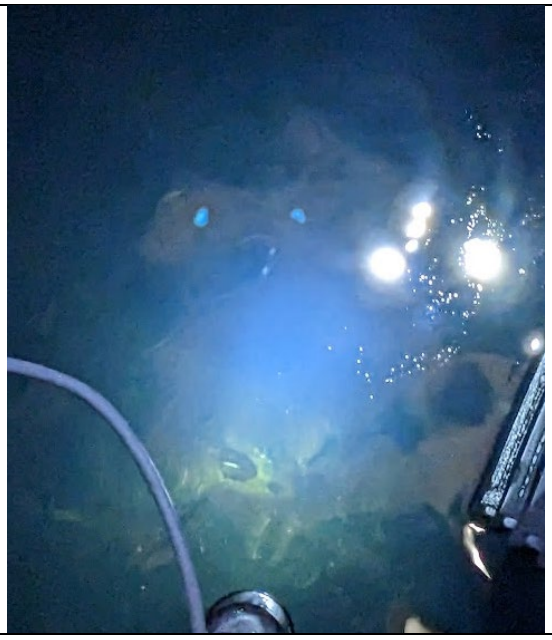

Figure 1 – Clearwell image showing dark material collecting on bottom.

Understand why the clear well effluent turbidity is not stabilizing. This is our highest priority right now. It was running in the 0.9-1.2 NTU range before permanganate optimization. It has shown periods of improvement to the 0.4 NTU range (target <0.1 NTU), but it will bounce back to the 1.2 NTU range. The filter 1 effluent is running <0.1 NTU, so we are observing increasing turbidity across the clearwell. Questions include:

- Is the material settled solids from the bottom of the clearwell? It was cleaned in the summer of 2022 and was not too dirty. We will try a new sludge judge to get a feel for what is on the bottom of the clear well.

We were not successful with the sludge judge because the valve was missing from the new sludge judge. We attempted to take photos of the bottom of the clear well as shown in Figure 1. The images are not very clear but show a dark material at the bottom of the clear well.

- The material at the bottom of the clear well looked like it could be anthracite filter media, but it isn't obvious that we are losing media based on a filter depth check. A depth check showed 47 inches from the top of the media in filter 1 to the top of the tank at several locations on the platform. This yields a media depth of 29.75 inches based on:
  - 102" depth top of tank bottom metal plate
  - -12" plenum / concrete fill at bottom of tank
  - -0.75" grout
  - -12.5" block height
  - -47" freeboard
- We double checked the media thickness using the measured distance of 76" from the top of the blocks to the top of the filter. Subtracting 47" from the top of the media to the top of the filter yields 29 inches of media.
- The operating manual indicates the media thickness should be 30" consistent with the calculation above. I expected to find the media missing 7" or more of depth based on prior measures. Perhaps the level is higher near the platform.
- Are we continuing to precipitate iron and manganese in the clear well? We seem to be pushing the max permanganate level to pink breakthrough. Jar testing seemed to indicate we were at a max and residence time was adequate. Perhaps chlorine pre-injection will be necessary for iron removal? We will test iron and manganese in and out of the filter. Continuing to Monitor the POE turbidity. We have expected it to drop by now. The new monitoring sheets may help us understand how manganese and iron are being removed over time.
- We are seeing some variability in the amount of permanganate we can add without breakthrough. The range has been 28-30% on the pump (250-270 ml/min & 3.0–3.2 ppm). Could feed variability through the day be causing periods of breakthrough and other periods where iron and manganese removal are less than adequate? Controlling this would be a challenge. Our plan is to test iron and manganese at plant start and near the end of the day to see how feed properties are changing.

Review proposed changes to the daily paperwork. The main change is 15-minute turbidity and chlorine recording sheet which has been effective in Forsyth. We won't start using the forms until we agree this is the right direction to go. There are two sheets we fill out every day that I have tried to adapt to the Hysham work process:

- A daily log with pre-startup readings, numbers to collect during operation, and some post operation recordings. Each sheet is saved in a 3-ring binder which is valuable for historical analysis.
- A daily turbidity and chlorine sheet were we record key parameters every 15 minutes. This is valuable for comparing a day's operation to prior days when something changes (like a little elevated turbidity). We also use this sheet to record some daily readings on one line. This form is also saved in a 3-ring binder and is the basis for part of our monthly reporting.

- I believe the two proposed sheets capture all the data currently collected on the following three monthly sheets:
  - Chemical inventory sheet
  - Sheet where the iron and manganese are recorded
  - "DAY SHEET" that has some turbidity readings, gallons, and the chlorine residual.
- We reviewed the proposed sheets and I think we agree to try them. We hope to start in early March.
- There are two other forms we can consider for Hysham that we currently use in Forsyth:
  - A chlorine contact sheet. I haven't seen this in Hysham yet. I could build one if we would like it.
  - A large monthly sheet that has a nice summary of values on 1 page. I keep most of this data in a spreadsheet now, but it is nice to have a stack of the large sheets to look back on when we have questions or issues. We would need a decent workspace to maintain this larger sheet.

Addressed Line Plugging to Analyzers

- The chlorine analyzer malfunctioned during the day. The failure may have been related to flushing the feed water line while validating the turbidity analyzer. Flow to both analyzers plugged off completely. The lines had to be disassembled and cut in one place to rod out black foulant that completely filled the ¾" piping network.
- Cleaning the lines restored pressures to the analyzers but had the sideeffect of causing the chlorine analyzer not to function because the pressure was too great for the internal valve to stop flow. Bill and Roy did a nice job building a standpipe pressure control system consistent with the analyzer manual that resolved the issue.

Discuss historical water usage. Hysham appears to be producing a lot of water for the size of the community. Hysham production needs can be estimated at 30,000 gal/day using the water industry rule of thumb of 6,000 gal/household/month. A production of 30,000 gal/day is also estimated by scaling Forsyth's production to Hysham's town size in population/households as shown below. Hysham is making about twice the water that is estimated from these methods. Are there historical production figures that might indicate a higher base, meter issue, or unaccounted water use? Water bills can be used to cross check production balances, but it is a considerable effort.

	Hysham	Forsyth	Hysham/Forsyth
Winter Production, GPD	60,000	160,000	1/3
Population	269	1,495	1/5
Households	157	720	1/5

- We discussed the high usage. Chad Thompson is planning to compare billed water to production. It is possible that high demand users like the cattle yard may explain some of the elevated water use.

Evaluate why the high service pumps are cycling so frequently. On 2/16/23 we reduced the lead pump setting from 125 ft to 123 ft and the lag pump from 122 to 120 ft. Plan to review the SCADA system to see if there was any positive impact on pump operation.

- We took pictures of the control cabinet. There are no time delay relays in the cabinet. The issues may be part of the PLC program.

Get photos of SCADA schematics / wiring diagrams for future troubleshooting.

- Not completed yet.

Install and run in air dryer with the recommended particulate filter on discharge.

- Roy and Bill completed this.

Troubleshoot ALUM pump which is pumping about 25% of pump curve.

- Check what we have for spare parts and what we might be able to fix.
- Make a list of pumps for each chemical.
- Not completed yet.

Prepare Diagram with parts list for chlorine system repairs.

- In progress.