Progress Report: Design Updates

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1 Introduction

AguaClara, a student project team at Cornell University, began in 2005 to develop sustainable water treatment technology. By working with local partners and program Alumni residing in Honduras and India, over a dozen gravity-powered surface water treatment plants have been built to serve communities around the world. Ground water treatment for arsenic and fluoride and energy neutral wastewater technologies are some of the new frontiers for the program, as well as the establishment of a global network of partners and beneficiaries of sustainable water technology. Communication between student research teams on campus and engineers and communities internationally is facilitated by the design team, a subset of the student project team which publishes and updates the AguaClara Automated Design Tool and other supplementary educational materials, like graphics to explain flow of water through the plant. The Automated Design Tool (ADT) allows any user to request a plant with unique flow rate and other construction dimensions and receive a detailed AutoCAD drawing of the plant along with a customized document describing each unit process in the design. Engineers on site must then convert this 3D drawing into useful construction documents along with structural and site design details: only the hydraulic components of the plant are provided by the ADT. The ADT uses LabVIEW to generate AutoCAD and Microsoft Word files based on Mathcad files which the design team students update each semester. Updates come from feedback from the field as well as research team findings. The usefulness of the tool is also being increased each semester with the addition of modular designs and more expert inputs. This report details progress in two areas of the ADT: the backwash lagoon and the High Rate plant drawing. The Miscellaneous section deals with additional minor changes to the code.

2 High flow Plant

Currently, the AguaClara Automated Design Tool (ADT) works well for standard plant user inputs from 16 Lps to about 60 Lps. Above 60 Lps, the tool generates more than the 10 sedimentation tanks as shown in Figure 1. As shown in Figure 2, the inlet and exit channels of the tank are very close to the floc hopper in the z direction. This is because, in order to ensure equal flow distribution between the many sedimentation tanks, the cross-sectional wetted area in the inlet channel must change. Therefore, at plant flow rates over 60 Lps, the sedimentation tanks can no longer be added to this bank. The proposed solution is the addition of a second treatment train which will include the sedimentation tanks and flocculation tanks. The total plant flow will be split between these two treatment trains after the entrance tank and will converge into a single treatment train in the filter inlet channel.

2.a Challenge Details

The multiple treatment train plant, as it is currently envisioned by the AguaClara engineers, involves mirrored flocculation and sedimentation trains with a single bank of filters. The first iteration of the design included a single entrance tank. This is shown below in Figure 3. The flow will be split into the two trains after the Linear Flow Orifice Meter (LFOM) and converge in the filter inlet channel. This will not change filter function as individual filters are already shut off in standard plants for backwashing and low flow conditions. The new plant design, shown in Figure 4, has multiple entrance tanks. The benefit of separating the entrance

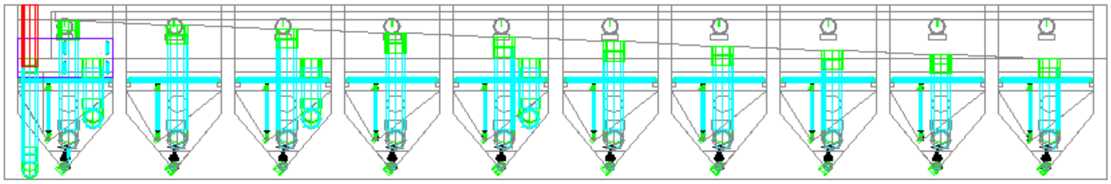


Figure 1: This is a side view of the 10 sed tanks in a 60 Lps plant. The inlet channel is seen to slope towards the flocculator on the right. This slope allows wetted area to decrease as flow decreases, maintaining a constant velocity in the channel. This constant velocity allows each sed tank to perform with the same initial head. In other words, equal velocity maintains equal flow distribution between tanks.

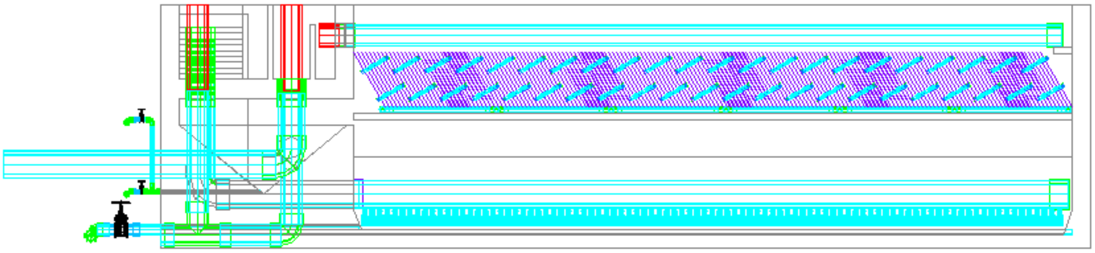


Figure 2: This view of the 60 Lps sed tank shows the inlet and exit channels on the left to be very close to the floc hopper weir which is directly to the right of the triangular floc hopper. The floc hopper is a weir to collect sludge trapped in the floc blanket of the sedimentation tank. If the inlet channel is forced to be any lower, the floc hopper may intersect the channels, which would be a failed design.

tanks is that independent dosing systems will allow plant operators to test their own dosing strategies in real time. Now, the trains split immediately after the chemical stock tanks.

Overall, there are three basic steps to designing the high flow plant algorithm:

1. Distinguish between total plant flow (Q_{Plant}) and train flow ($Q_{Plant} = \frac{Q_{Plant}}{/}2$)
2. Determine which existing components need to be mirrored (and therefore doubled) or rotated (and simply moved without using the adjusted train flow value)
3. Add all required connection plumbing or channels. This will occur when the train diverges and converges: after the chemical stock tanks and before the filter inlet channel.

Specific design steps are detailed below.

2.a.1 Entrance Tank

The new entrance tank configuration has two primary constraints: simplify design to reduce cost and maintain an ability to turn off one train. Because the chemical dosing system relies on a linear relationship between flow and height of water, there must be one LFOM separating the entrance tank from downstream components. Unfortunately, the dosing itself must occur in each individual entrance tank. In order to accomplish this, a system of 3 LFOMs was initially devised.

The first LFOM will handle all flow and control the dose, while the second LFOM will be used for mixing of coagulant with the raw water, rapid mix, and travel to a single flocculator. The first LFOM will lead to a tank with the two other LFOMs. When one train is shut down using a pipe stub over one of the secondary LFOMs, the linear relationship will still be maintained. This configuration is shown in Figure 5.

Figure 6 shows the initial implementation of the entrance tank. In the design file, separate variables for Q.Train were made so that they did not interfere with the single train LFOM. These are characterized by

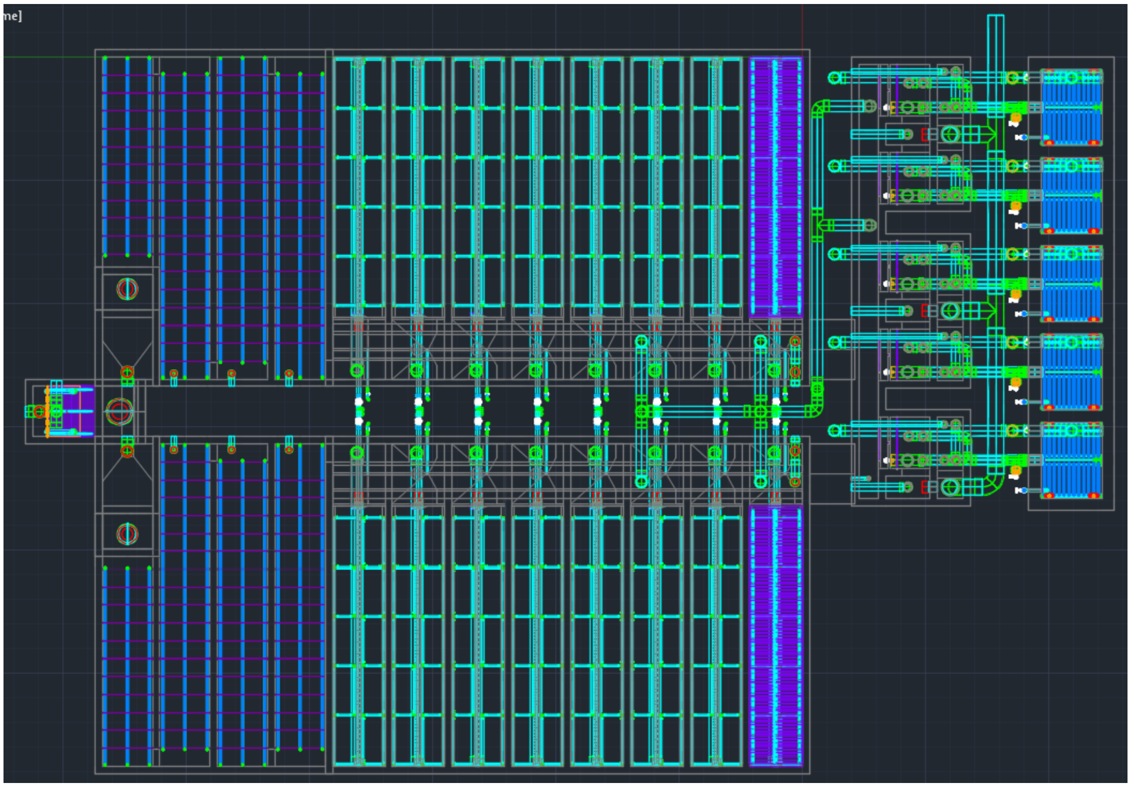


Figure 3: This shows a 95 Lps two train plant. The flocculators and sed tanks are designed for 47.5 Lps. The filters and entrance tank are designed for 95 Lps.

the word 'Split' appended to the variable. In the drawing file, the new 'Split' variables were used to draw the two smaller entrance tanks. The tank was extended below the first LFOM and parts of the concrete were subtracted to make the tanks into one continuous tank. The large entrance tank was rotated and moved to a point defined based on the width of the drainage channel. The result of this implementation is shown in Figure 6. This point is used to mirror the two trains of the plant and is called "mirrorpt". The red pipe stubs show the drainage pipes for the secondary tank. No pipe stubs have been drawn over the LFOMs, and would need to be cut so that they fit on the sloped concrete.

Ethan Keller, a program Alumni working in Honduras, and Monroe Weber-Shirk, the Director of AguaClara, have been consulted about this design. Keller has expressed a concern that this entrance tank is too large and complicated. Further discussion led to the decision to separate the dosing system between two entrance tanks so that operators will have to dose the trains independently. Not only will this design enable operators to shut down one train, but it will maintain the linear dosing relationship when one train is shut off. The division of flow between trains will occur upstream of the plant, either using a check valve in the supply pipe or a tank similar to the previous design with two exits.

The major drawback of the independent entrance tank design is that different trains will have to be dosed and adjusted separately. Interestingly, this complexity is also seen as a valuable learning experience for operators. Independent dosing will allow operators to directly compare different dosing strategies using the settled water turbidity. This ability for operators to experiment and learn during plant operation will be especially useful for very high turbidity flows, where AguaClara knowledge is incomplete. The extra burden on the operator to adjust two dosing systems is not seen as a risk by Monroe or Ethan.

An additional benefit of this design in the ADT is that the entrance tank design will require no updates. The entrance tanks at Q.train flow rate will be mirrored along with the rest of the train. Now, the chemical stock tanks will connect to two separate constant head tanks and chemical dosing systems.

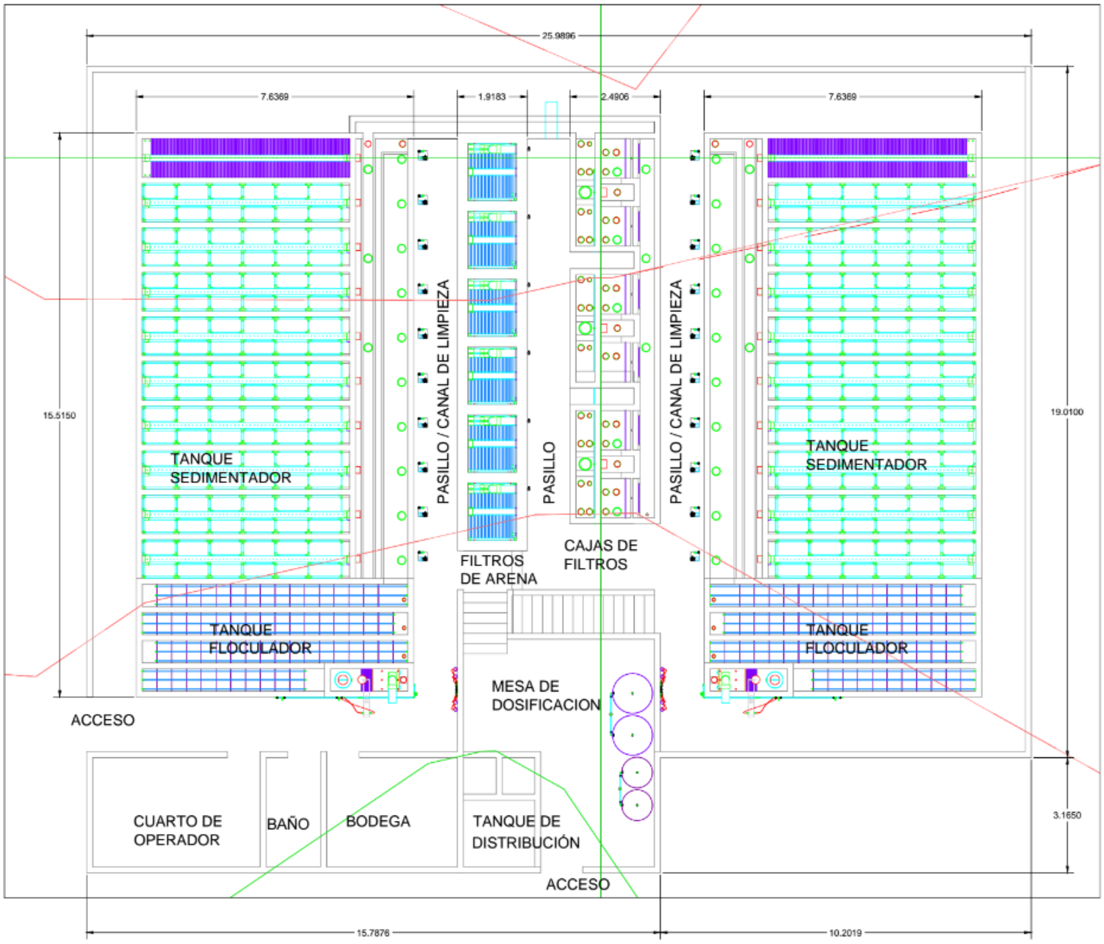


Figure 4: This shows a 120 Lps two train plant from the design for the Las Gracias plant. The entrance tanks, flocculators, and sed tanks are designed for 60 Lps. The filters and entrance tank are designed for 120 Lps. This single entrance tank option is not longer being considered.

2.a.2 LFOM

For some reason, the LFOM code does not work above 100 Lps. This error needs to be fixed in order to draw high flow plants. One possible solution to this is to use a 2D LFOM instead of a pipe, which should not share the geometry constraints of the pipe. Because of the new entrance tank design, this challenge has been put on hold as LFOMs for flows greater than 60 Lps will not be needed.

2.a.3 Sedimentation Tank

The first iteration of the design for the connection between the sedimentation tanks and the filters was a continuation of the existing single train plumbing. For this design, the only change to the sedimentation tank was the length of the pipes leading from the exit channel to the filter. These were modified so that a T-connection may fit between them on the ”mirrorpt” centerline. A separate script called ”Splitscript” was created in the drawing file as shown in Figure 7. This script is not drawn until after the rest of the plant has been mirrored, because it is not mirrored with the rest of the sed tank bank.

After feedback from Monroe and experts in Honduras, the sedimentation tank exit channel will be extended to connect with the filter inlet channel. This means that, for high flow plants, no sed-to-fi plumbing will be drawn. In the Sedimentation Tank drawing file, an if-statement will determine whether plumbing will be included or not. This is the only change to the sedimentation tanks in the revised high flow design.

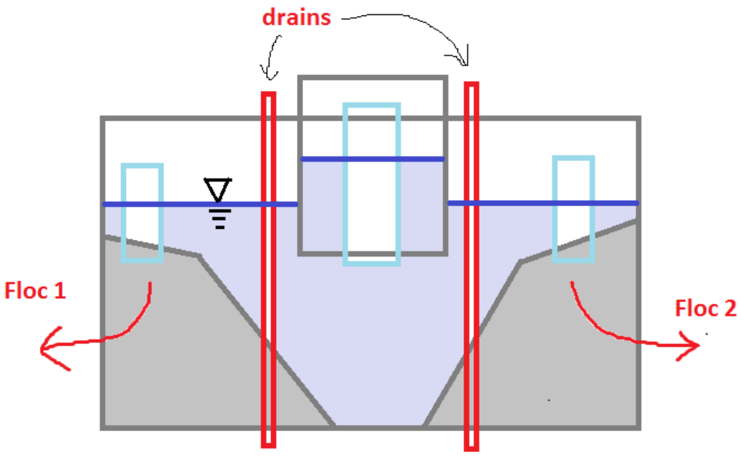


Figure 5: This is a simplified sketch of the entrance tank for a two train plant. In the center, a single large LFOM flows into a secondary tank. This tank has two smaller LFOMs which only serve to connect the tank to the flocculator. A pipe stub can be placed by a plant operator over one of the LFOMs to block flow into one train of the plant. The purpose of the secondary tank is to make sure that the entrance tank where dosing is controlled is not hydraulically connected to the rest of the plant: dosing should work equally well whether there are 2 trains or 1 in use.

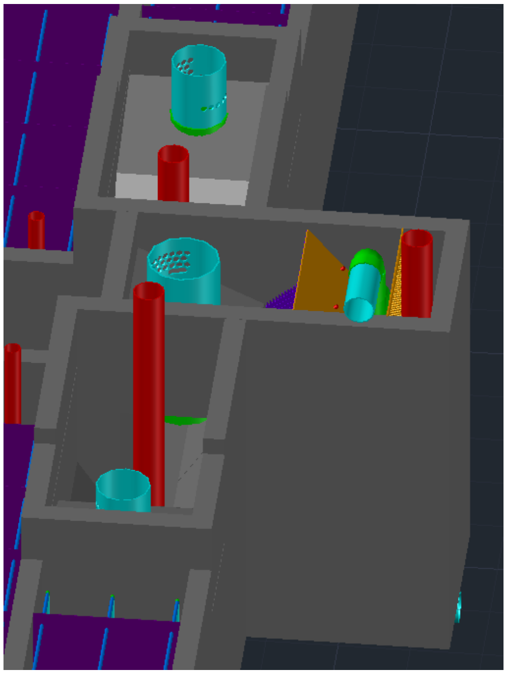


Figure 6: This shows an AutoCAD rendering of the initial entrance tank design for a 95 Lps plant. This feature looks very similar to the standard entrance tank design.

2.a.4 Filter

The plant mirroring occurs in the filter code. The filter drawing code that is used in the master high flow file (EtFlocSedFiHigh) uses the variable AC.FilterHigh instead of the standard AC.Filter because the rotation, mirroring, and extra connection scripts are all stacked on to this new variable. In the first iteration of the design, a new connection script picks up where the sedimentation script left off in connecting the Filter Inlet

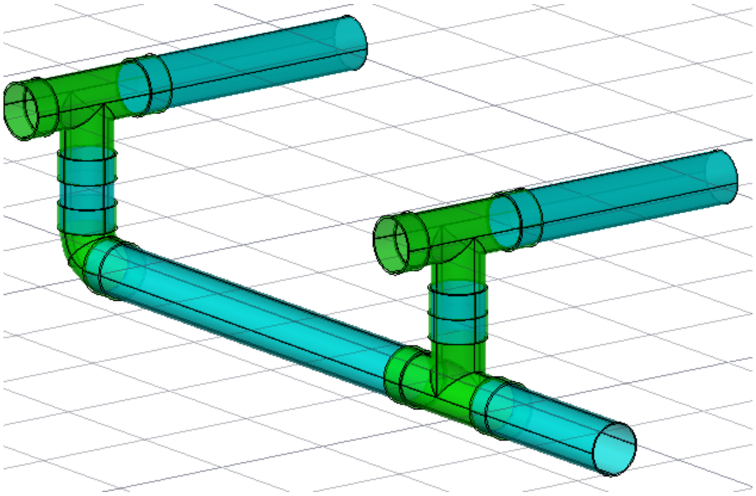


Figure 7: This shows an AutoCAD rendering of the 2-train sed-to-fi plumbing that is defined in the sed tank drawing file.

Channel through elbows to the plumbing. This is shown in Figure 8.

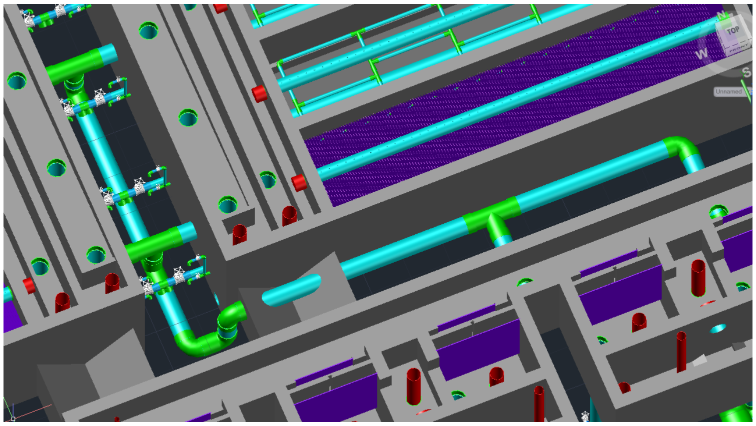


Figure 8: This shows an AutoCAD rendering of the connection plumbing between the sedimentation tank exit channel and the filter inlet channel. This plumbing will be inside the drainage channel of the plant.

As previously mentioned, the second iteration of the high flow design does not include this plumbing. Although the plumbing is complete, the experts do not think that all of this extra plumbing is necessary. The next iteration of this design will involve a continuation of the concrete sedimentation tank exit channel into the filter inlet channel and the elimination of the plumbing. Unfortunately, this will interrupt the operator walkway as the water level and plant freeboard are above the elevation of the walkway. A ramp with walls may be used to cross the channel. The proposed design is shown in Figure 9. The implementation of this structure is discussed in the Operator Access section of the report.

2.a.5 Filter Inlet Channel

With the new design for connecting the filter to the sedimentation tanks, flow from the sedimentation tanks will now enter the filter inlet channel from one end exclusively. In the standard design, flow enters from somewhere in the middle. This difference in design is shown in Figure 10. Because flow enters from one end, pressure recovery and equal flow distribution are a concern. The filter entrance weirs maintain equal flow distribution between filters by creating large head losses. Pressure recovery relates to increased head at the

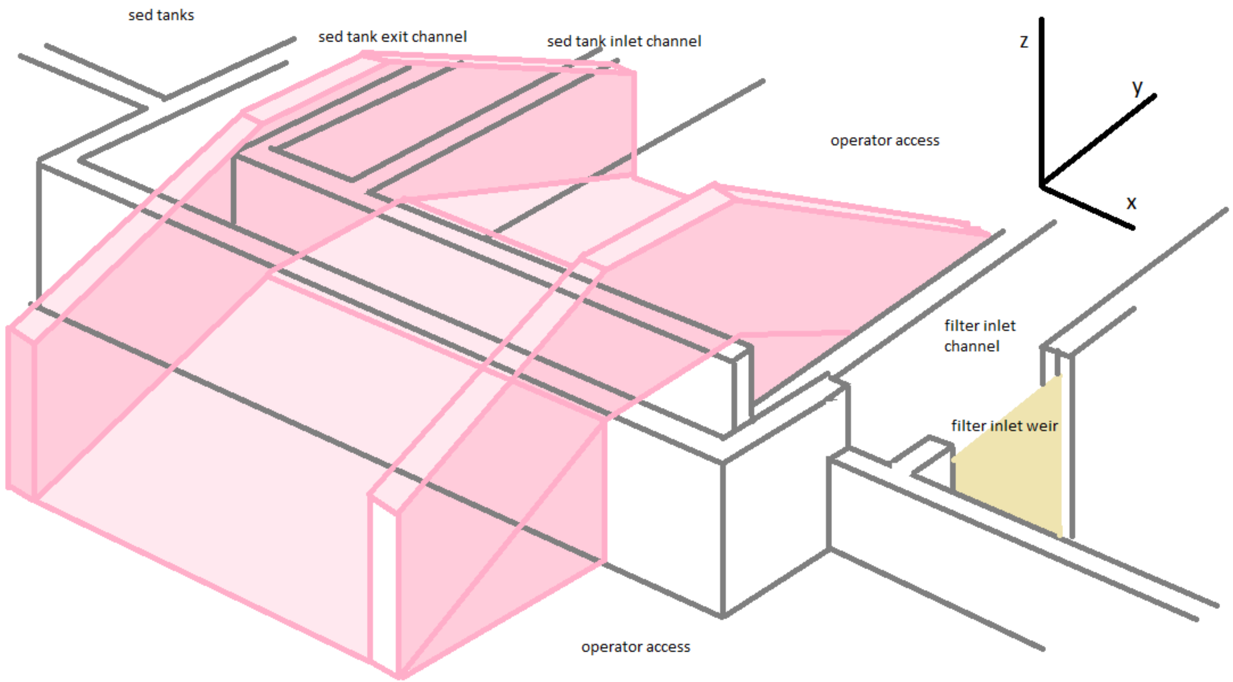


Figure 9: This sketch shows the operator access ramp that will cross the sed-to-fi channels in high flow plants. This ramp will include short walls to prevent debris from being kicked into the sed tank or filter inlet channels.

stagnant end of the channel when kinetic energy is converted to potential energy. Therefore, the width of the channel must be large enough so that the velocity in the channel is small and does not create a large pressure recovery head.

The standard design uses the flow through one filter, Q.fi, to calculate the required width of the channel. For a 120 Lps plant, this width is about 35 cm. The Q.fi value is appropriate when the flow enters the channel in the middle or at different locations. In the new high flow design, where the entire plant flow enters from one end, the design flow for the channel must be the entire plant flow, Q.Plant. The new width of the channel using this larger flow is closer to 180 cm. This is a significant change in the design, resulting in a much larger filter area. Because of the flow distribution constraint in the filter, though, it is important that velocity in the filter inlet channel remain low. After consulting Monroe, the decision was made to increase the depth of this channel in order to both reduce velocity and width.

2.a.6 Operator Access

In order for operators to access all parts of a multi-train plant, the concrete platform and stairs must be expanded. For the platform around the sedimentation and flocculation tanks, the entire floor including cuts was mirrored without replacement (meaning that the original and copy were kept) and unioned into one object. For the stairs leading to the plant basement and chemical stock tanks, each new object and cut was mirrored with replacement. The complete operator access schematic for a multi-train plant is shown in Figure 11.

Ramps were also added to allow plant operators to climb over the new channels connecting the sedimentation tank exit channel and filter inlet channel. This design involved wedges and subtraction. Monroe has suggested that the ramps be lowered below the freeboard in the channel to reduce their length. The floc hopper viewer holes must also be extended through the ramp. Currently, some are obstructed.

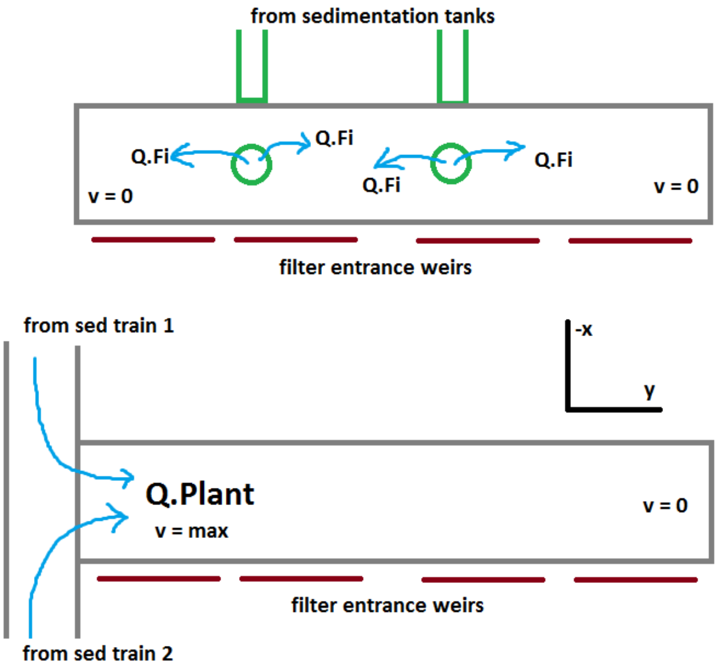


Figure 10: This sketch shows the different flows experienced by the filter inlet channel for standard and high flow designs. The top image shows the standard design where flow is dispersed in the center of the channel. The bottom image slows that all flow enters from one end of the channel. The pressure recovery term will be much larger in the bottom image than in the top because the change in velocity is greater.

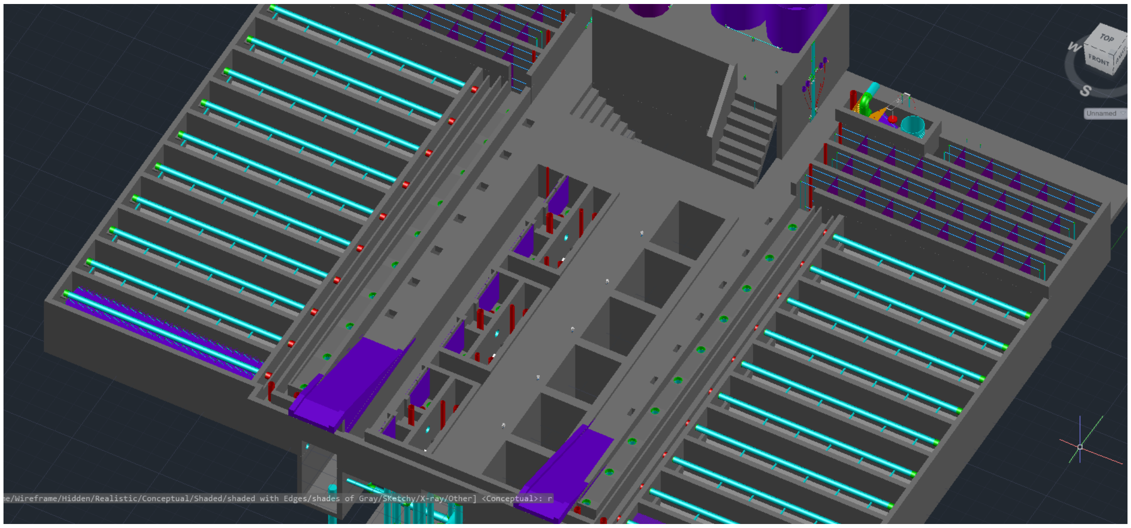


Figure 11: This shows an AutoCAD rendering of the connection plumbing between the sedimentation tank exit channel and the filter inlet channel. This plumbing will be inside the drainage channel of the plant.

2.a.7 Chemical Stock Tanks

For the two-train plant, the chemical platform is reduced in size by the longer filter gallery. Although specific designs may extend this platform, structural components are not within the scope of this design and have been omitted. Therefore, the platform remains small. As a result, the chemical storage tanks are too large for the platform. In addition to the existing two options for tank configuration, a third has been added specifically for two-train plants. This new layout is shown in Figure 12. The plumbing connecting the chlorine tanks to he drainage channel and the plumbing connecting all stock tanks to two independent dosing systems remains to be drawn. Unfortunately, this challenge for a single train took an entire semester, so this may not be finished before the end of the year.

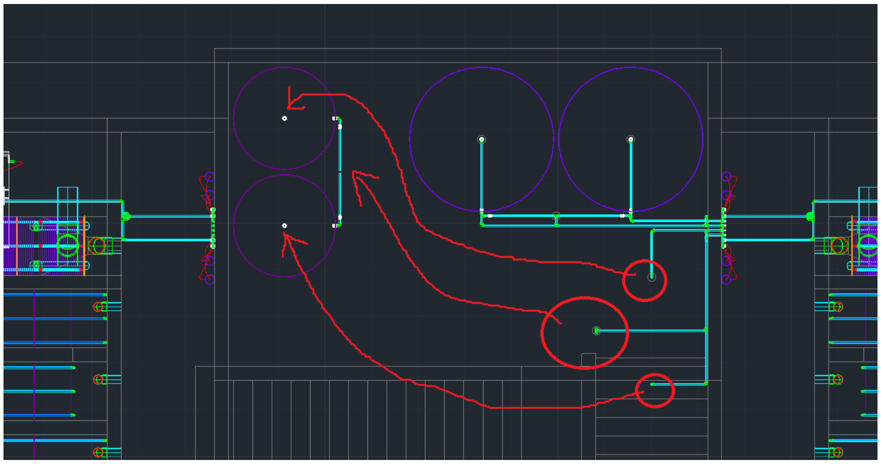


Figure 12: This shows an AutoCAD rendering of the connection plumbing between the sedimentation tank exit channel and the filter inlet channel. This plumbing will be inside the drainage channel of the plant.

3 Backwash Lagoon

AguaClara plants currently use a drain channel to discharge sludge, waste water, and backwash water from the plant. This channel has no treatment, and is open to the environment. Two problems with this are pollution of plant chemicals into the environment (coagulant) and water waste during dry seasons. Therefore, a backwash lagoon attached to the drainage channel which is able to retain plant waste water and and cycle it back through the plant when necessary is desired. Currently, the AguaClara engineers in Honduras have designed two alternatives for the plant at Zomorano, but neither design has been implemented. This semester, a team of designers is working on a backwash lagoon for an existing plant.

3.a Challenge Details

This challenge has many potential directions, including research of different pumps, review of the Zomorano designs, and calculations of the necessary volume of the lagoon. The volume of water wasted during one backwash cycle has been calculated with the backwash team as shown in Equation 1. For a 20 Lps plant, this amounts to about $4m^3$ of water. Depending on the frequency of backwash, the lagoon should be able to accommodate some number of backwashes at one time while a pump gradually transports water back to the entrance tank. The number of backwashes that need to fit in the lagoon depend on the frequency of backwashes and the rate of the pump.

$$V_{backwash} = A_{filter} * u_{backwash} * t_{backwashcycle} \tag{1}$$

There is little data on backwash frequency in AguaClara plants. This is partially due to the fact that the current plants have no filter or different iterations of the new OStaRS technology. Therefore, filter performance is not only poorly understood, but not expected to be consistent plant to plant. In addition to this lack of filtration history, the data on backwash frequency itself is poor quality. Speaking with AguaClara engineers has confirmed that, though plant operators at their respective plants have good intuition for how often filters should be backwashed, actual records are partial at best and often inaccurate. The frequency of backwashing will be studied this semester to contribute to the future of the backwash lagoon challenge.

The primary source of data are the Google fusion tables calculated using the Plant Operator Smartphone Tracker (POST) app. These tables have about four months of data from Moroceli and Jesus de Otoro which include backwash events and timestamps. Using this data, the time between successive backwashes was calculated for each plant. A model was developed to simulate a backwash tank and pump system. Given the volume of the tank, the time between backwashes, and the flow rate of the pump, the reliability of the tank can be calculated for the given data. This model shows the tradeoff between pump rate and tank volume. In the case where solar pumps are used, the flow rate is lower, so a larger volume of tank is needed.

3.a.1 Simulation Model

The model of backwash tank performance given data on successive time between backwashes for the two plants shows the AguaClara design team how reliable different tank and pump combinations are likely to be in the summer. It is good to keep reliability high because this means less water waste and less environmental contamination. On the other hand, the size of the tank and the type of pump relate to the cost of the system. A more powerful pump or a pump that uses more sustainable solar power is more expensive than a traditional pump. Different pump alternatives are shown in Table 1. A larger tank also implies higher construction costs. There are three objectives in this problem: sustainability, cost, and reliability. Sustainability refers only to whether a traditional or solar pump is used. The solar pumps (3, 4, and 5) are more expensive but less powerful.

Table 1: Possible backwash recycling pumps

Number	Description	cost	Source	Lps
1	Everbilt 1/6 HP Plastic Utility Pump	$94.98	Home Depot	8.4
2	Wayne 1/10 HP Portable Transfer Utility Pump	$94.49	Home Depot	5.0
3	Solaray Solar Water Pump Kit - 409 GPH	$199.99	1000fountains.com	0.43
4	Ambiente Remote Controlled Solar Water Pump Kit - 211 GPH	$129.99	1000fountains.com	0.22
5	Solar Water Pump Kit - 79 GPH	$89.99	1000fountains.com	0.08

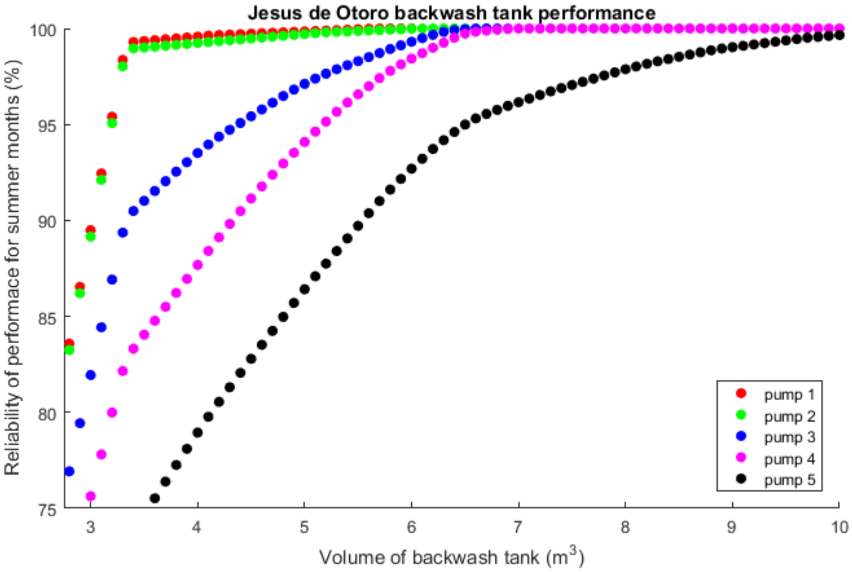


Figure 13: This plot shows backwash recycling system reliability over the summer months for different pumps and different tank sizes for Jesus de Otoro.

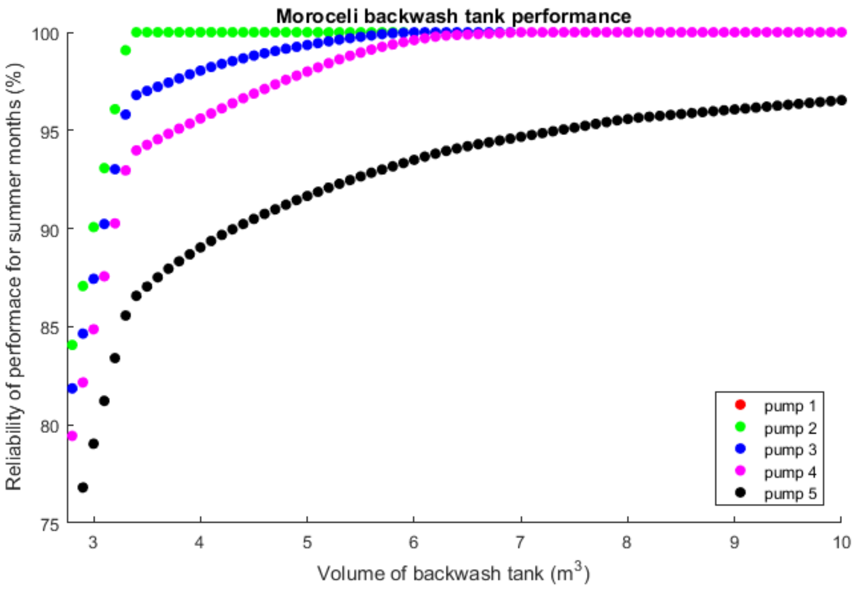


Figure 14: This plot shows backwash recycling system reliability over the summer months for different pumps and different tank sizes for Moroceli

These objectives are competing. Trade-offs between objectives are shown in Figures 13 and 14. These plots, developed using Matlab, show that as tank size increases, reliability increases. They also show that more powerful pumps are more reliable even for smaller-sized tanks. Unfortunately, the differences in the data from the two plants are also apparent in the plots. Uncertainty is also ignored in this simplistic analysis. Additional sources like plant sludge and sinks like evaporation from the exposed tank are not considered. The pumps are all expected to operate at maximum capacity whenever needed, which is not likely. Still, this simple analysis may help inform a general design for future plants.

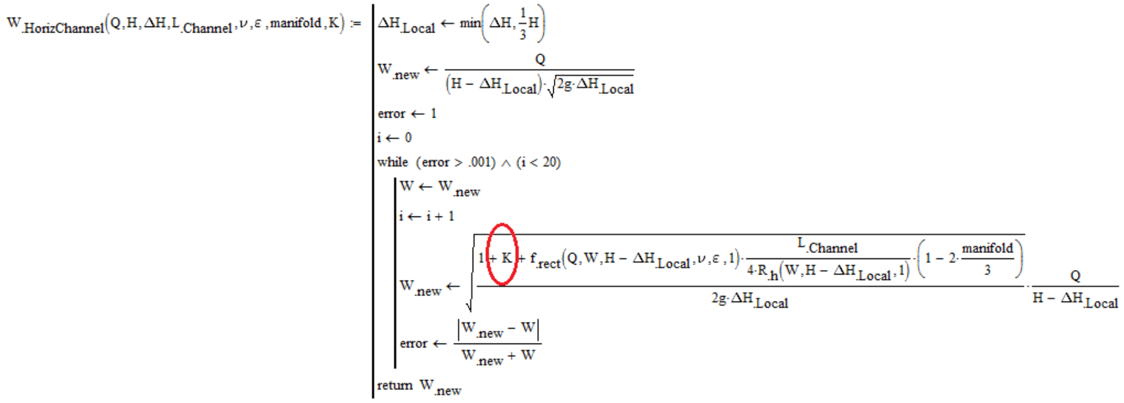
4 Miscellaneous

Since the beginning of the design team, the ADT has been touched by many hands. The quick turnover rate of students and designs means that many features of the design tool become dated and neglected. Some errors or oversights in the code that are corrected in the field are not quickly updated, while some changes to a unit process are not checked for compatibility with all parts of the code. These small errors are reported to the design team by Alumni in the field and quickly fixed. Such instances during the Spring 2016 semester are documented below.

4.a Pressure recovery equation

Pressure recovery is the phenomenon where velocity in a pipe or channel is converted into increased height of the water when, at the end of the pipe or channel, the velocity drops to zero. If velocity is large, the height difference in water at the end of the channel and water at the beginning may be significant. The formula for calculating the pressure recovery term in a simple pipe is $height = \frac{v^2}{/} 2g$ from the conservation of energy equation. Pressure recovery may be a large source or error when the pipe or channel is designed to have equal distribution of flow at any point along the pipe. For equal flow distribution to be possible, the velocity and height of the water cannot change significantly compared to the head loss through the entrance to the connected pipes or channel.

The Mathcad equation shown in Figure 15 uses an iterative process to calculate the width of a channel necessary to satisfy the pressure recovery constraint. The 'k' input was added to the equation to account for



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$W_{.HorizChannel}(Q, H, \Delta H, L_{.Channel}, \nu, \varepsilon, manifold, K) :=$
    $\Delta H_{.Local} \leftarrow \min\left(\Delta H, \frac{1}{3} H\right)$
    $W_{.new} \leftarrow \frac{Q}{(H - \Delta H_{.Local}) \cdot \sqrt{2g \cdot \Delta H_{.Local}}}$
    $error \leftarrow 1$
    $i \leftarrow 0$
    while $(error > .001) \wedge (i < 20)$
        $W \leftarrow W_{.new}$
        $i \leftarrow i + 1$
        $W_{.new} \leftarrow \sqrt{\frac{1 \boxed{+ K} + f_{.rect}(Q, W, H - \Delta H_{.Local}, \nu, \varepsilon, 1) \cdot \frac{L_{.Channel}}{4 \cdot R_{.h}(W, H - \Delta H_{.Local}, 1)} \cdot \left(1 - 2 \cdot \frac{manifold}{3}\right)}{2g \cdot \Delta H_{.Local}}} \cdot \frac{Q}{H - \Delta H_{.Local}}$
        $error \leftarrow \frac{|W_{.new} - W|}{W_{.new} + W}$
    return $W_{.new}$
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Figure 15: Monroe's Mathcad function to calculate the minimum channel width to satisfy the pressure recovery constraint. This equation has been updated to include minor losses in the channel with the K term that is circled.

minor losses in the channel, such as those caused by a bend. The change was made to the fluids function, and then values of k = 0 were added to the function at all calls in the code. This function is used in the sedimentation tank and filter design files at this time. Should future channels be drawn with bends, the k value should be changed to 1. This may need to occur in the exit channel of the sedimentation tank.

4.b Sedimentation tank bug fixes

The AutoCAD layering scheme used by AguaClara designers is meant to increase understanding by viewers. Layer colors indicate different materials, like concrete, pipes, fittings, and plastic sheets. The team's coding guidelines direct members to include each new object in its own layer. This pattern was ignored in the subtracted objects in the Sedimentation Tank. This led to concrete components of the floc hopper drawn in a plumbing layer. A separate layer for all subtracted objects was created and added to the code to ensure that such ambiguity does not weaken the design. This bug fix also included switching the direction of the floc hopper extrusion from negative to positive so that the side slopes were drawn correctly. This change is shown in equation 2.

$$ExtrudeSedHopper = ExtrudeLast(W.SedBay) \tag{2}$$

4.c Filter dirty water headloss

As filters become dirtier, the head loss through the filter increases. In Honduras, plant operators typically backwash the plant when the effluent turbidity increases, meaning that colloids are short-circuiting the clogged filter. Operators are finding that the filter entrance tank is spilling over the overflow weir before this failure mode is reached. Experts in Honduras think that this pre-mature overflow in the entrance box is leading to more backwashes than necessary. Therefore the variable HL.FiDirty has been increased from 40 to 60 cm. This constant value was also moved from the Filter design file to the Expert Inputs file. Now, the plant operators can observe dirtier filters to find the true failure point. Though this change increases total plant headloss by making the filters deeper, it should also reduce water waste due to excessive backwashing.

5 Future Work

Addressing the high flow code is the current focus of the team. The next step for high flow is to implement the next iteration of the entrance tank and the sed-to-fi connection. The most recent iteration of the design for the Las Gracias plant has been sent to Experts in Honduras for feedback. The team is also working with Jingfei and Nicholas on the Backwash challenge to supplement their more specific design with general backwash data.

Future work for the AguaClara design team should be updates to the flocculator and entrance tank. In the Entrance Tank, for large flow rates, the LFOM pipe and coupling become excessively large. The implementation of a 2D LFOM should be considered. This idea has been passed along to Honduras for feedback (Figure 16). The Flocculator should also be considered for updates due to the new research into more efficient floc construction. Lastly, plants with 3 or 4 trains should be designed. The layout of these plants should be planned with Monroe and experts in the field.

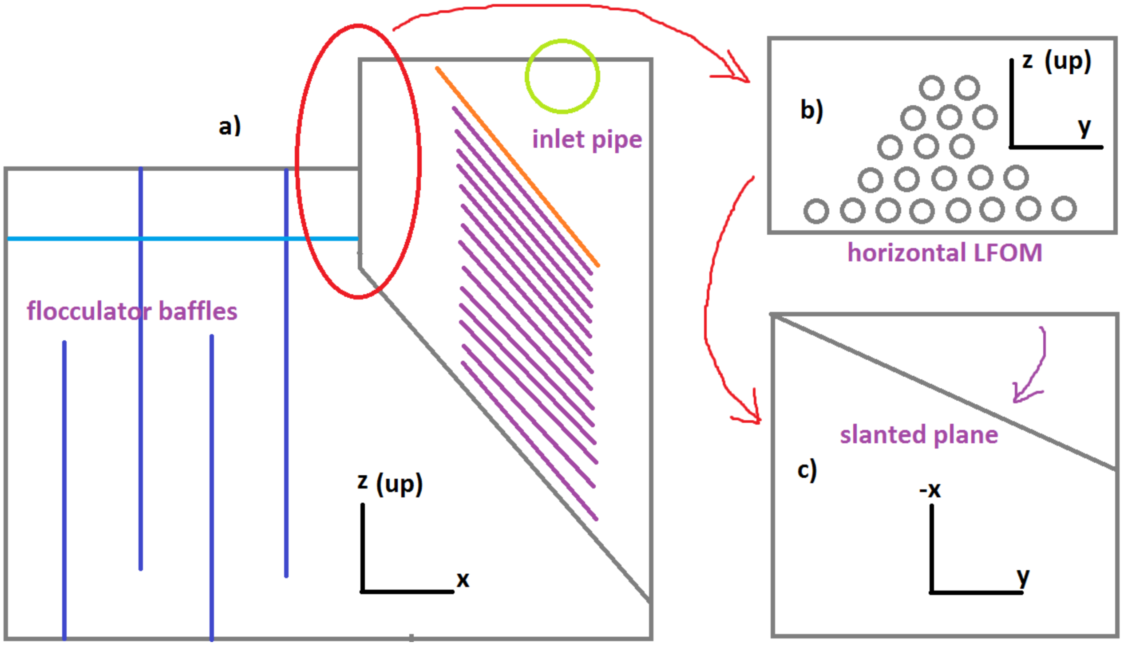

Figure 16: This shows the possible 2D LFOM build with a plastic sheet other than a pipe. Part c of the diagram shows that the plate may be slanted to accommodate longer bottom rows of orifices. This may give designers more flexibility when building larger LFOMs.

Overall, the design tool organization uses design and drawing files for each unit process where hydraulic and construction constraints are added to the plants. The method files reference the drawing and design files and are used to produce designs on the servers. In the past, different method files had different drawing and design files. For example, there were separate 'SedimantationTank' files for low flow, standard, and high flow plants. This organization system is not only difficult to maintain but misrepresents the design. The technology is fundamentally the same for low, standard, and high designs– construction just leads to slightly different layouts and structures. These superficial differences can mostly be handled with simple 'if-statements' at the end of drawing files. The decision to mirror a two-train plant 'if Q.Plant ¿ 60 Lps' is an example of this simple addition to the drawing code. The use of if statements will allow drawing and design files to be the same for all method files. This consistency means that changes or additions to the code will not be forgotten in other methods. In terms of future steps to honor this new organization strategy, the low-flow method file must be redone. One of the changes needed is to define the number of sedimentation tanks based on flow. For larger plants, the minimum number of tanks is three. Though all AguaClara plants should have sed tank channel systems, allowing for the easy addition of more tanks as demand increases, there should be only one tank for 5 Lps and 2 tanks for 10 Lps. The specific transition between 1, 2, and 3 tanks must be determined by consulting with experts. Monroe has also suggested that the sed tank design should be more uniform. The impact of such a decision will be studied by research teams in later semesters before the design choice is made.

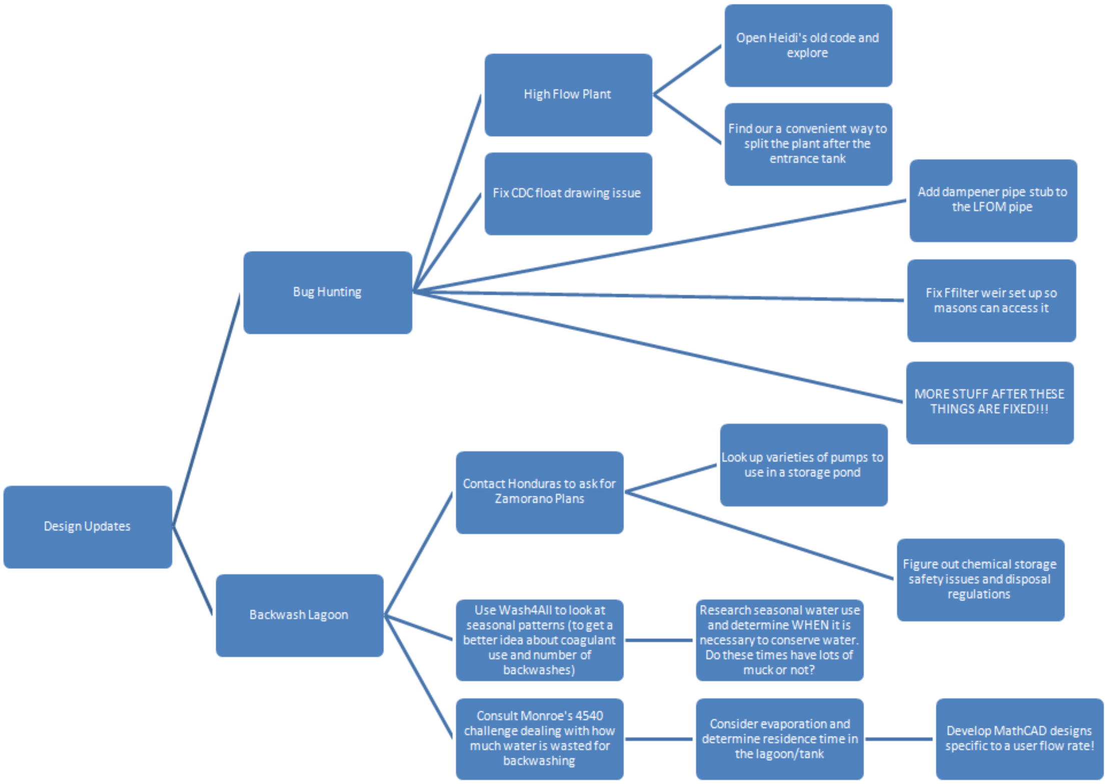

Figure 17: Task Map

6 Task Map

6.a Task Map Details

- Bug Hunting
  - High Flow Rate Plants
  - Other interesting tasks to be found in the challenges
- Backwash Lagoon
  - Contact Engineers in Honduras for the recent backwash lagoon and backwash tank designs for the Zamorano plant
  - Study plant operation data to look for seasonal patterns
  - Look at CEE 4540 DC for the calculations of water waste in a single backwash cycle to begin thinking about a Mathcad design file