FIELD ASSESSMENT REPORT AND RECOMMENDATIONS

Based on Koi Pond Life Support Systems Site Visit – April 29, 2015

Project Name:	Site Location:	Date:
Hakone Gardens	Saratoga, California	6/30/2015

GN	GENERAL NOTES

Introduction:

Mr. Paul Cooley, National Aquatics Leader of PCA, completed a site visit of the Hakone Gardens Koi Pond on April 29, 2015.

Based on discusssions with staff Jacob Kellner, Gardner for Hakone Gardens, we have developed a flow schematic, which illustrates the current system. (See Figure I)

SUM	Summary of Recommendations

We have reviewed the design and operation of the system and have the following recommendations:

1. Immediate and Shortterm (See Alternative 1 Schematic)

Based on our current understanding we recommend the following shortterm improvements.

a. Double the Flow through the Pond. Increase the flow rate through the pond by doubling the flow through the gravity gravel filters. We believe the filters can handle twice the flow they are currently operating. This would require a redesign of the pumps, sizing the system and validating the pipe sizes. Hopefully this can be done without significant piping changes. If the Hakone Gardens wants to accomplish this without major engineering costs we could probably increase individual pumps one-at-a-time until the piping sizes are maxed out. PCA would be willing to work with the staff to accomplish this. Now as the flow increases, the gravel filters will probably need to be cleaned more frequently, but that is the purpose, to get more solids out of the system at a more rapid rate. This will require more operator time.
b. Re-operate the pressure sand filter/UV system. The system is probably not really adding any benefit to the pond water quality. We would recommend checking the filter media (size, quality), rebuilding the filter, if necessary, remove the pump suction from the sump and connecting it to the gravel filter discharge, increase the flow (doubling it), increase the size of the UV unit and develop a budget and preventative maintenance on the UV bulb replacement, develop a method of correctly backwashing this filter by either installing a separate backwash pump that connects to the gravel filter discharge and wastes to a storage tank (this water can be used for irrigation) or try and utilize the waterfall pump to double duty as the filter backwash pump. Validation of using the waterfall pump would require some investigation into the actual size of this pump and the hydraulics to and from the pump location to the pressure filter site. The cost of a new pump vs. using the waterfall pump would need to be compared.
c. Get a rigorous vacuuming in place. The staff has an improved vacuuming pump on order. The existing pump is inadequate. A new positive displacement (preferably a diaphragm pump) needs to be used and the vacuuming procedure needs to be developed and rigidly provided until the water system can be improved.
d. Review feeding procedures. We believe the poor fish health is a result of high levels of bacteria in the system caused by overfeeding and an inadequate filtration to remove the accumulated organics and subsequent bacteria. Either the system will need to be upgraded or the amount of feed needs to be reduced (or both) to improve water quality and fish health. The adjustment of the feeding procedures needs to occur in conjunction with a fish (Koi) expert.

e. Monitor temperature, ammonia and nitrate. We believe the nitrate test is not measuring correctly. Either the test kit needs to be upgraded or samples should be sent out to an outside lab. It would be nice to know the nitrate level. In addition, it would be nice to measure total bacteria in the pond. This could be sent out to an outside lab.

2. Long Term Solutions

Once money is available we would recommend the following long term solutions (See Alternative 2 Schematic)

a. Replace the entire filter system with a bead filter/UV system. Double the flow.
b. Redesign the entire pool by installing supply and return pipes that distribute the flow more evenly through the pond (eliminating dead spots and short circuiting).
c. Deepen the pool in at least one area to give the fish a sanctuary from predators.
d. Move the LSS equipment away from the current location to allow for adequate space and isolation from the public. (Location to be determined)
e. Develop a full wastewater recycling system within the water system to allow complete utilization of the bead filter backwash for soil amendment on the Garden site.
f. Consider (after carefully monitoring the temperatures) installing temperature control on the system to reduce stress on the fish. This might include heating and/or chilling.
g. Monitor pond nitrates to determine the buildup of nitrate in the system. Adjust the flushing to control nitrates below acceptable levels.

GN	GENERAL NOTES

Basically, the system consists of the following components:

1. A return sump
2. Five filter and recirculating pumps
3. Four gravity gravel filters
4. One pressure sand filter
5. An Ultraviolet Disinfection system (currently not functional)
6. Blower
7. A waterfall pump
8. Vacuum pump (currently not working very well)
9. Well. The system can be supplied from a small 2gpm well. This operated only intermittently. Most of the fill is done off the potable water system.

Water currently leaves the pond through a single pipe outlet located in one corner of the pond and gravity flows to a return sump. This return sump is 95-inches x 45-inches and approximately 12 feet deep (18.5 gallons/inch). The sump is cleaned yearly (4 hours/year).

GN	GENERAL NOTES

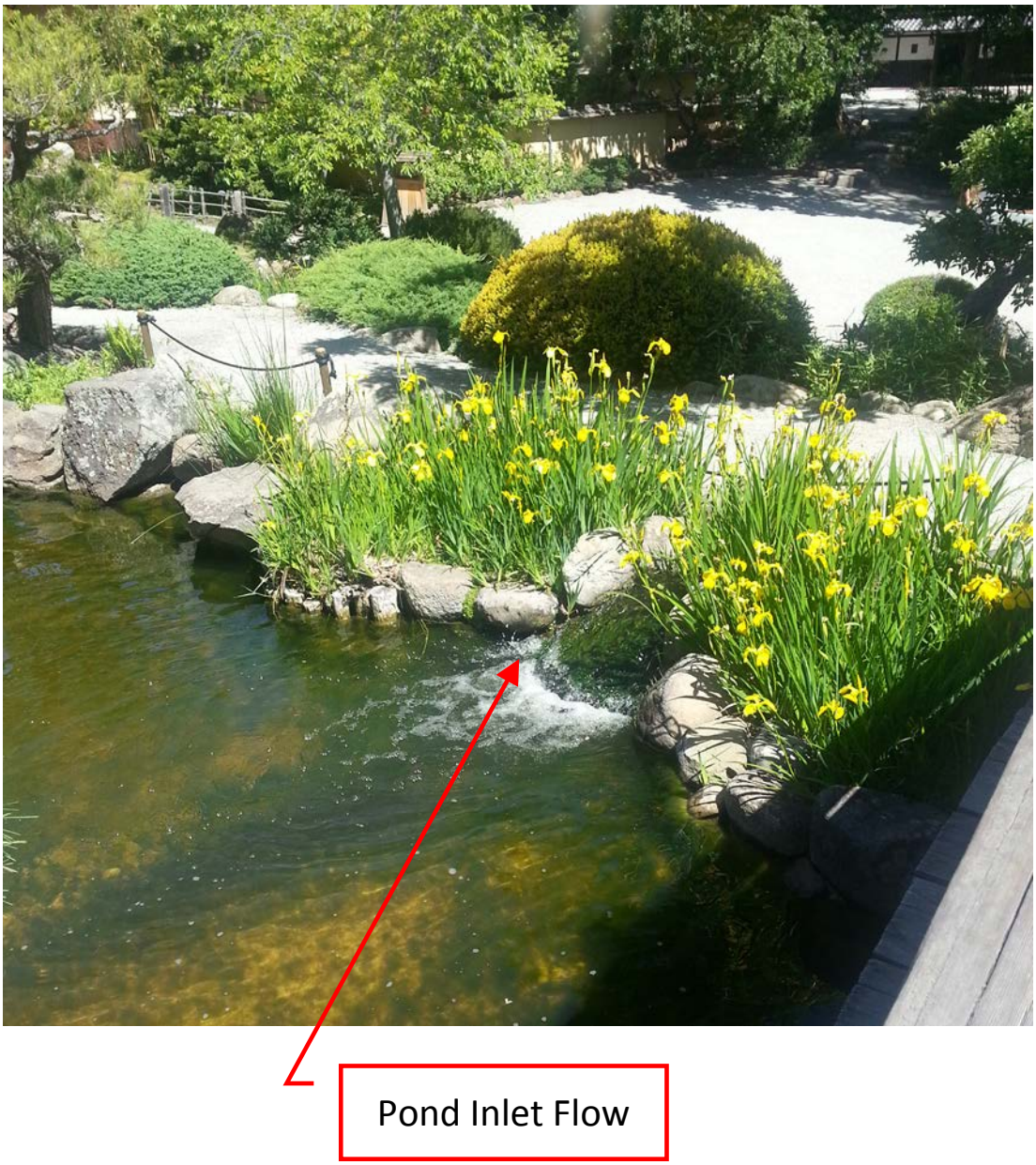
Water is drawn out of the sump with five small fractional horsepower pumps (1/4HP/pump, 2-inch line, measured flow approximately 27gpm/each by timing the drop in the sump level with the pond outlet blocked).

GN	GENERAL NOTES

Four of the recirulating pumps discharge to four gravity gravel filters. The filters are backwashed by stopping the flow, draining the water back into the sump, refill from the bottom and aerate, drain back into the sump, scrape the detritus off the top of filter (along with some gravel), separate the gravel, put gravel back into the filter, dump the remaining detritus into the garden, turn on filter pump. This is done weekly and it takes about 30 minutes/filter x 4. Every year the entire media is removed and cleaned and replaced into the filter. This takes about 2 hours/filter x 4. The filter's media is usually pretty clean in the yearly cleanings.

GN	GENERAL NOTES

Water flows by gravity from the gravity gravel filters back to the pond through a single inlet.



GN	GENERAL NOTES

One of the recirulating pumps flow from the return sump to a single 36-inch pressure filter. The pressure filter is backwashed once or twice a week to the storm drain. The blower is operated to assist backwashing.

GN	GENERAL NOTES

Discharge from the pressure filter returns to the common discharge from the gravity filters through an in-line UV unit, which is currently not operational. The staff said that the cost of replacement bulbs was excessive and no observed benefit was observed when the UV was operational.

001	COMMENTS

General Animal Loadings:

Currently there are approximately 30 large Koi, 20 small Koi and 8 turtles in the pond. There are also one Heron and a couple of migratory ducks on a regular basis. The loading is low.

General Water Quality Testing:

The day of the site visits, the exhibit water quality was observed. Fish were visible and water clarity was viewed as adequate. The operators said that they clean the pond daily (probably 4-5 days a week) by brushing the pond using a swimming pool brush and then netting the floating algae using a swimming pool net. This usually yields one to two buckets of algae per cleaning (depending on the time of year). Algae grows considerably faster in the summer time when temperatures and lighting are higher. If the cleaning doesn't occur the algae grows up, preventing the fish viewing.

pH, ammonia, nitrite and nitrate were measured and showed:

1. pH above 8.8 (exceeded to range of the test)
2. Ammonia, nitrite and nitrate were all reading near zero. Note: it is highly unlikely that the nitrate is zero in this system.

002	COMMENTS

Vacuum System

The system currently has a portable vacuum system that consists of a pump with attached strainer and bag filter. This system doesn't work because the bag filter clogs quickly. This needs to be replaced with a diaphragm pump and hose that can discharge into the gravity filters.

003	COMMENTS

Water Supply

Water is supplied to the pond through either a small well (which only operates intermittently and shuts down automatically on low level) or from the potable water system. The majority of the fill water is coming from the potable water system. The potable water for the entire garden comes from a private water system which receives water by tanker trucks. The cost of this water was unknown. The Garden needs to get the cost of this water to PCA. Currently, the majority of the water entering the system is needed to make up for backwash of the pressure filter and leakage/evaporation. The Garden has estimated this to be approximately 11000 gal/month**.**

Pond Feeding Schedule

Currently the Koi pond is fed from three sources:

1. Guest Purchase Feed. Visitors are allowed to purchase fish food ($1/half cup) and allowed to feed to Koi. Feeding quantities vary seasonally but staff estimate the total food at 150-200 lbs/year. When water temperature drops below 50 degree F, zero cups. When water temperature is between 50 and 60 Degrees F, 7 cups per day (depending on sales). When temperature is above 60 Degree F feed rate is 10 to 11 cups/day.
2. Supplement from staff. When sales are low, the staff supplements the feed.
3. Public uncontrolled. The public are discouraged from bringing their own feed but some violate this request.

Staff adjust the feeding based on the foraging activity of the fish. When the fish show less interest the feed is reduced.

Animal Health

Currently, the Koi present have considerable health problems and mortalities are observed throughout the year. The cause of the health problem is unknown but it assumed that it is related to water quality. PCA recommends that a biologist be utilized to determine the exact cause of poor animal health. Causes could be:

1. Water quality
    a. Temperature Fluctuations. The pond has no positive temperature control and reaches high temperatures in the summer (when ambient temperatures rise above 100^{o}F) to low temperatures during the winter when air temperature drops below freezing. There are times when the top of the pond actually freezes.
    b. pH Fluctuations
    c. Algae
    d. DO
    e. Pathogens
2. Nutritional
3. Husbandry
    a. Feeding Methods
4. Predators

004	COMMENTS

Dechlorination

The operators currently are using Crystal Clear for dechlorination of the potable water when water is added. Crystal Clear is a sodium thiosulphate based material and is therefore a reducing agent. The procedure for adding this material needs to be reviewed and adjusted.

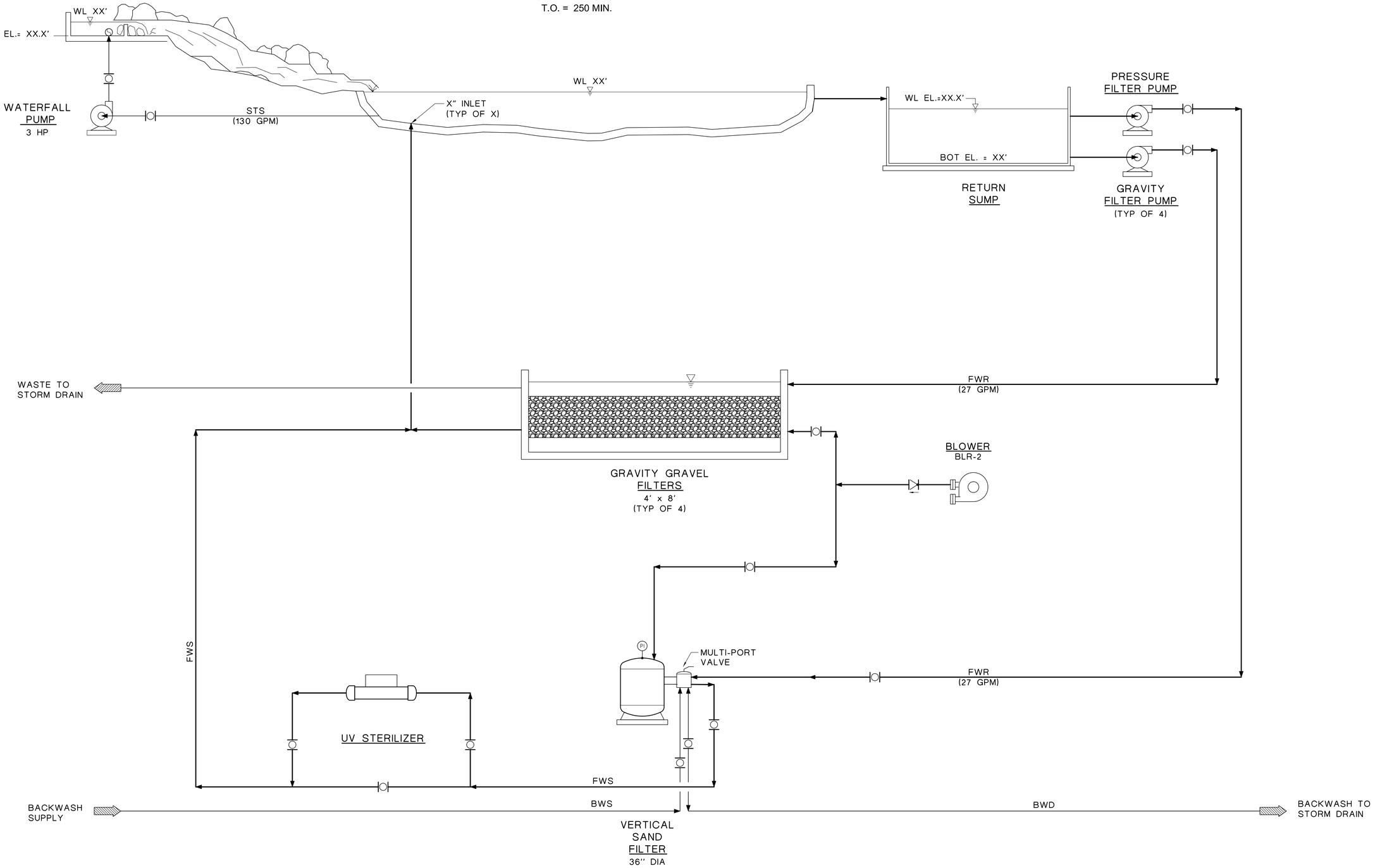
005	COMMENTS

Waterfall

The waterfall is important to the operation of the pond. It provides for circulation and aeration. The system consists of a 3HP pump which is variable speed. The pump was indicating a flow of 130gpm. This wasn't verified. Flow out of waterfall seems closer to 250gpm. The piping is designed to allow for a smaller side river located adjacent to the water fall. It is currently not working because of leakage.

HAKONE GARDENS KOI POND

TOTAL VOLUME = 33,000 GALLONS
FLOWRATE = 132 GPM
T.O. = 250 MIN.



HAKONE GARDENS KOI POND - LSS PROCESS FLOW DIAGRAM
EXISTING CONDITIONS
Figure 1

Date of Last Update: 05-16-15

PRELIMINARY
NOT FOR CONSTRUCTION

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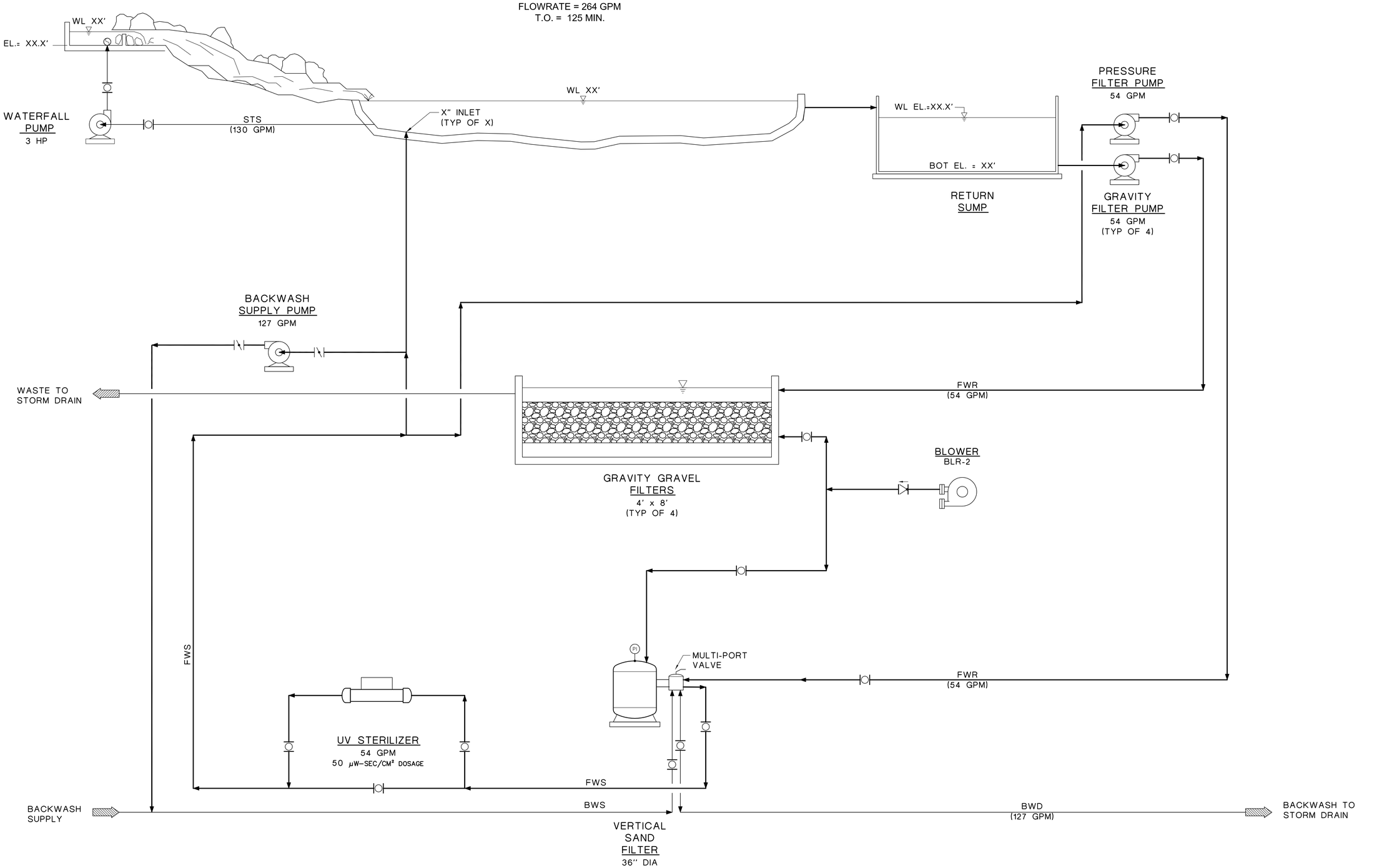
ALTERNATIVE 1 MODIFICATION

HAKONE GARDENS KOI POND

TOTAL VOLUME = 33,000 GALLONS
FLOWRATE = 264 GPM
T.O. = 125 MIN.



HAKONE GARDENS KOI POND - LSS PROCESS FLOW DIAGRAM
ALTERNATIVE 1 MODIFICATION

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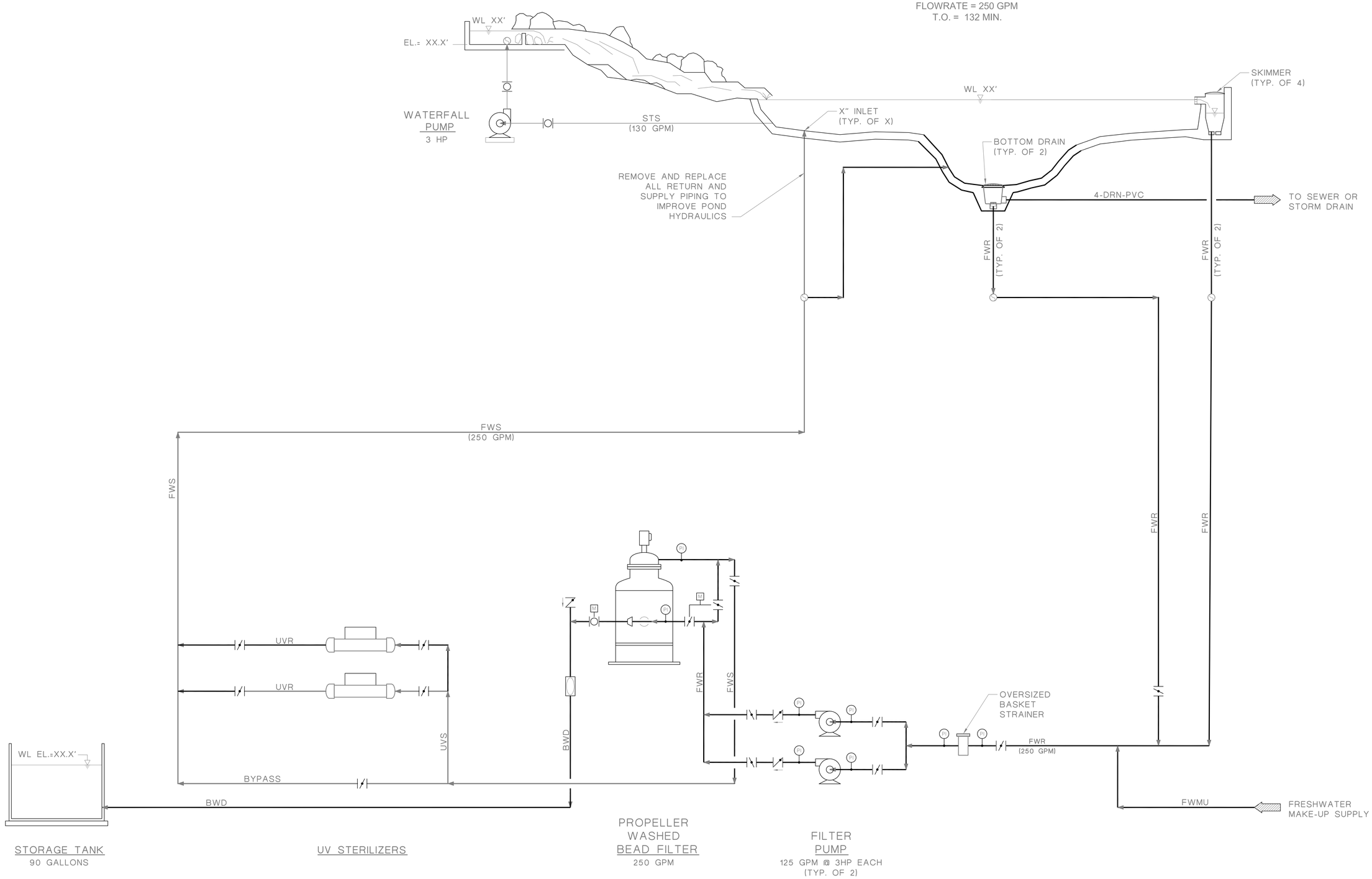
ALTERNATIVE 2 MODIFICATION

HAKONE GARDENS KOI POND

TOTAL VOLUME = 33,000 GALLONS
FLOWRATE = 250 GPM
T.O. = 132 MIN.



STORAGE TANK
90 GALLONS

UV STERILIZERS

PROPELLER WASHED BEAD FILTER
250 GPM

FILTER PUMP
125 GPM @ 3HP EACH
(TYP. OF 2)

HAKONE GARDENS KOI POND - LSS PROCESS FLOW DIAGRAM
ALTERNATIVE 2 MODIFICATION

Date of Last Update: 06-16-15

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