Dockwater Collection and Treatment System

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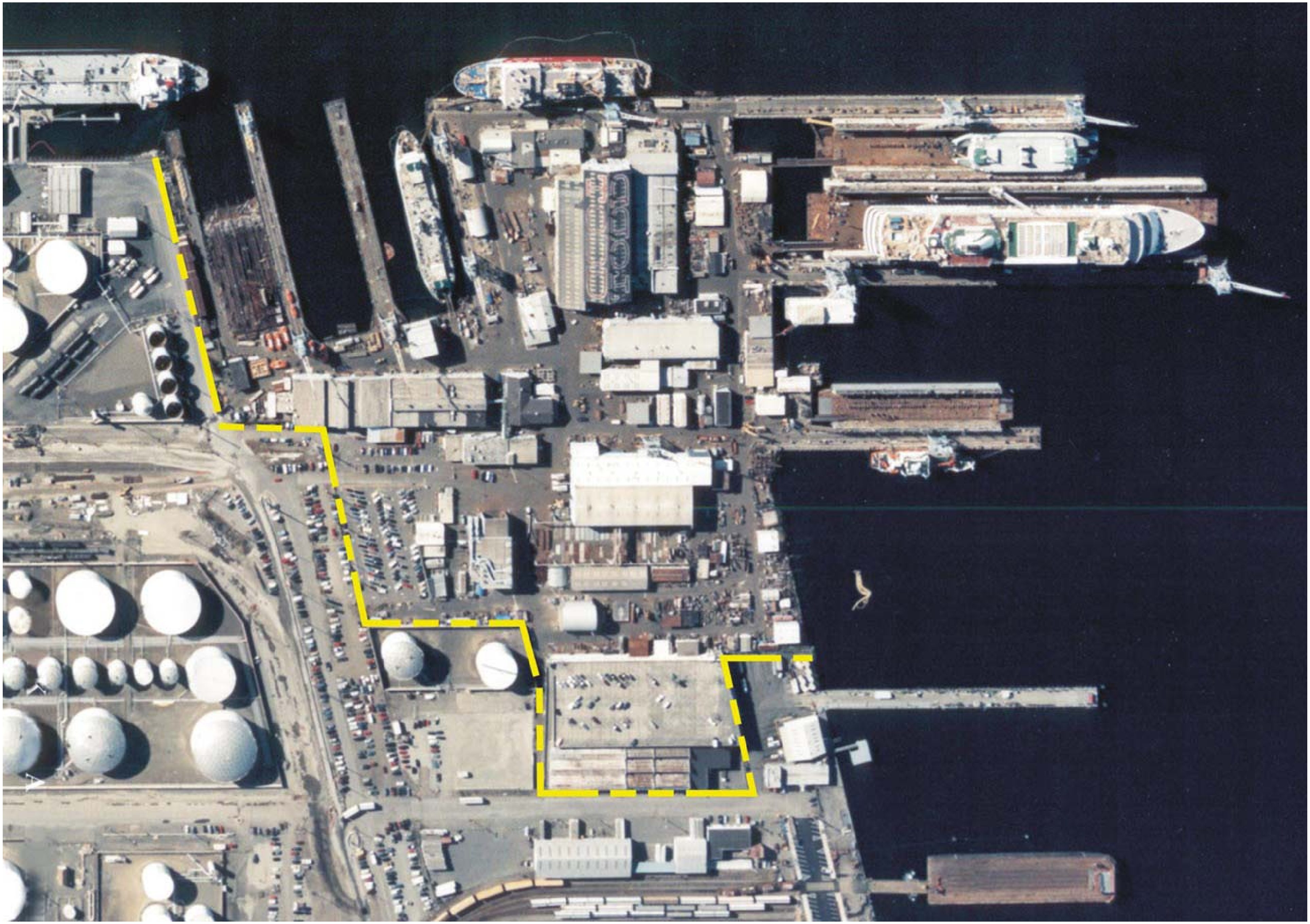


Drydocks at Todd Shipyards

TODD PACIFIC SHIPYARDS DOCKWATER SYSTEM

- Required by NPDES
- All water that hits the decks of the drydocks when work is underway is collected and processed
- The collected water is processed and discharged to sanitary sewer

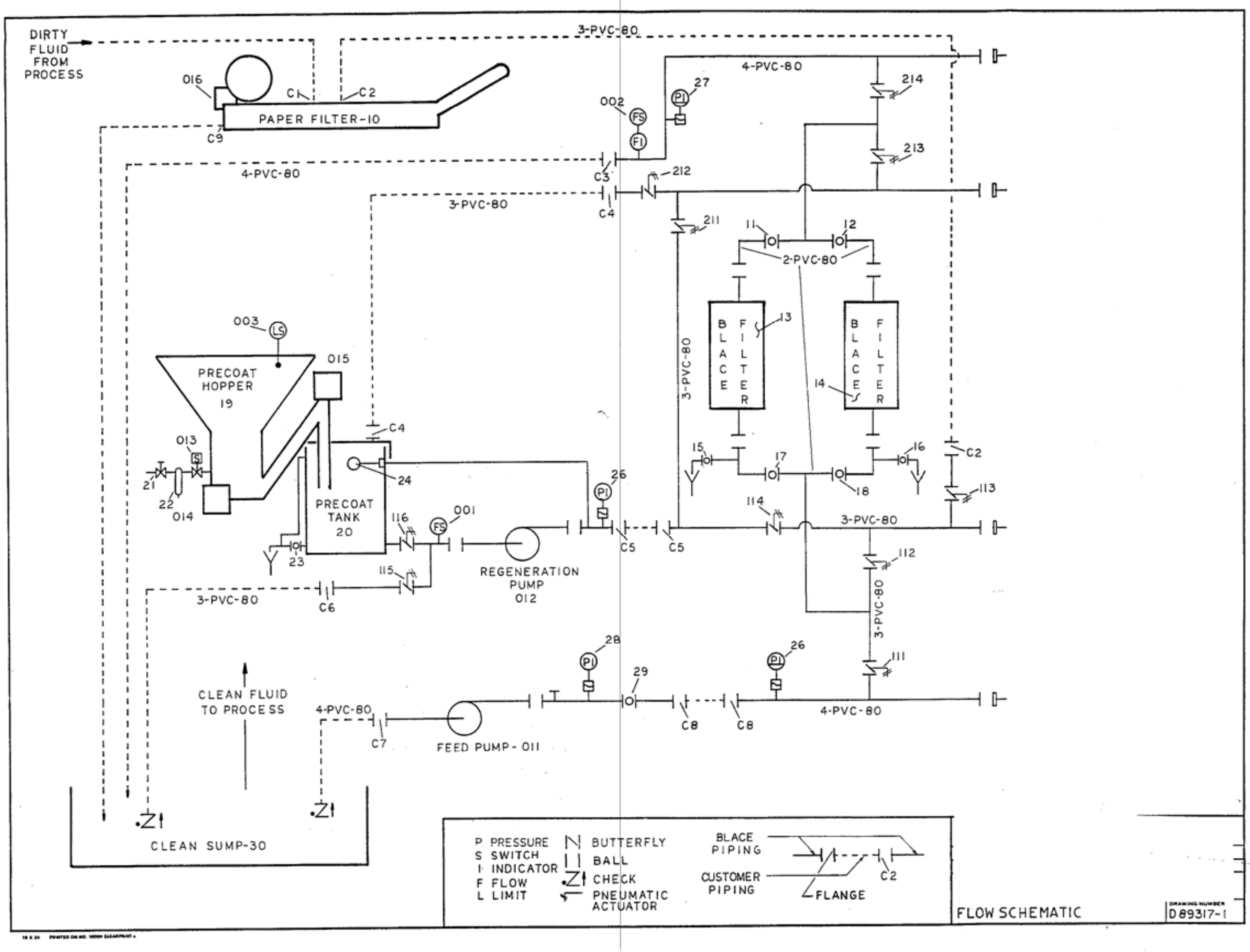
Dockwater – Original Requirements

- Original NPDES required that all Ultra- High Pressure Hydro-blast (UHP) water be collected
- Collected water was to be sent to Sanitary Sewer
  - System sized to handle UHP (6 gpm/unit) & high pressure wash water (2.3 gpm/unit) from docks
  - Discharge limits were set for daily total flow (45,000 gallons), copper (3.0 mg/l), zinc (5.0 mg/l), and lead (2.0 mg/l)

Dockwater – Todd's First System

- INSTALLED IN 1992 consisting of:
  - Diatomaceous Earth filter system designed for 20 gpm originally installed based on AKART studies
  - Vacuum collection system used that could transfer up to 100 gpm under best conditions (high tide, no leaks in piping, hoses, etc.) from docks
  - Small 220 gallon sumps installed on ends of drydocks to collect process water

System Diagram



System Did Not Meet Needs

- Existing dockside holding system and shore based filter systems were frequently overwhelmed
- Filter system was labor intensive.
- Dock configuration allowed water to flow directly to bay
- Future NPDES permits to require stormwater to be collected in both industrial land areas and drydock water

Upgrades Required

- Need for greater sump capacity on dock to match expected water generation and transfer rates
- Need for new filter system with greater capacity, lower manning & maintenance requirements

General Sizing Considerations

- The Dockwater System upgrade was based on stormwater combined with the highest amount of process water reasonably generated coincident with storm event
  - Dept of Ecology Stormwater Design manuals indicated that system designs should be based on a 5 year storm event
  - Stormwater generation from a 5 yr storm was calculated as a gallon per minute flow rate based on a constant rate of rain over 24 hours (2.1 inches over 24 hrs)
  - Industrial wastewater generation rate was based on a maximum number of High Pressure Water Wash Units (6) and Ultra-High Pressure Hydroblast units (3) that may be operating at any given time

Dockside Improvements

- Two 2500 gallon sump tanks were added to the ends of each steel drydock
- Sumps were sized to hold max water generated by a 5 yr storm and industrial process water during vacuum tank-to-filter system feed tank transfers took place
  - Vacuum system is disabled during transfer to feed tank
- Tanks were sized based on the larger of steel drydocks
- Common size & design used for both docks.
- Existing "escape" paths from drydocks were sealed

Transfer System Improvements

- Existing vacuum transfer system was considered adequate when combined with larger dockside sump tanks
- Back-up air driven pumps were installed at each sump

Filter System Improvements

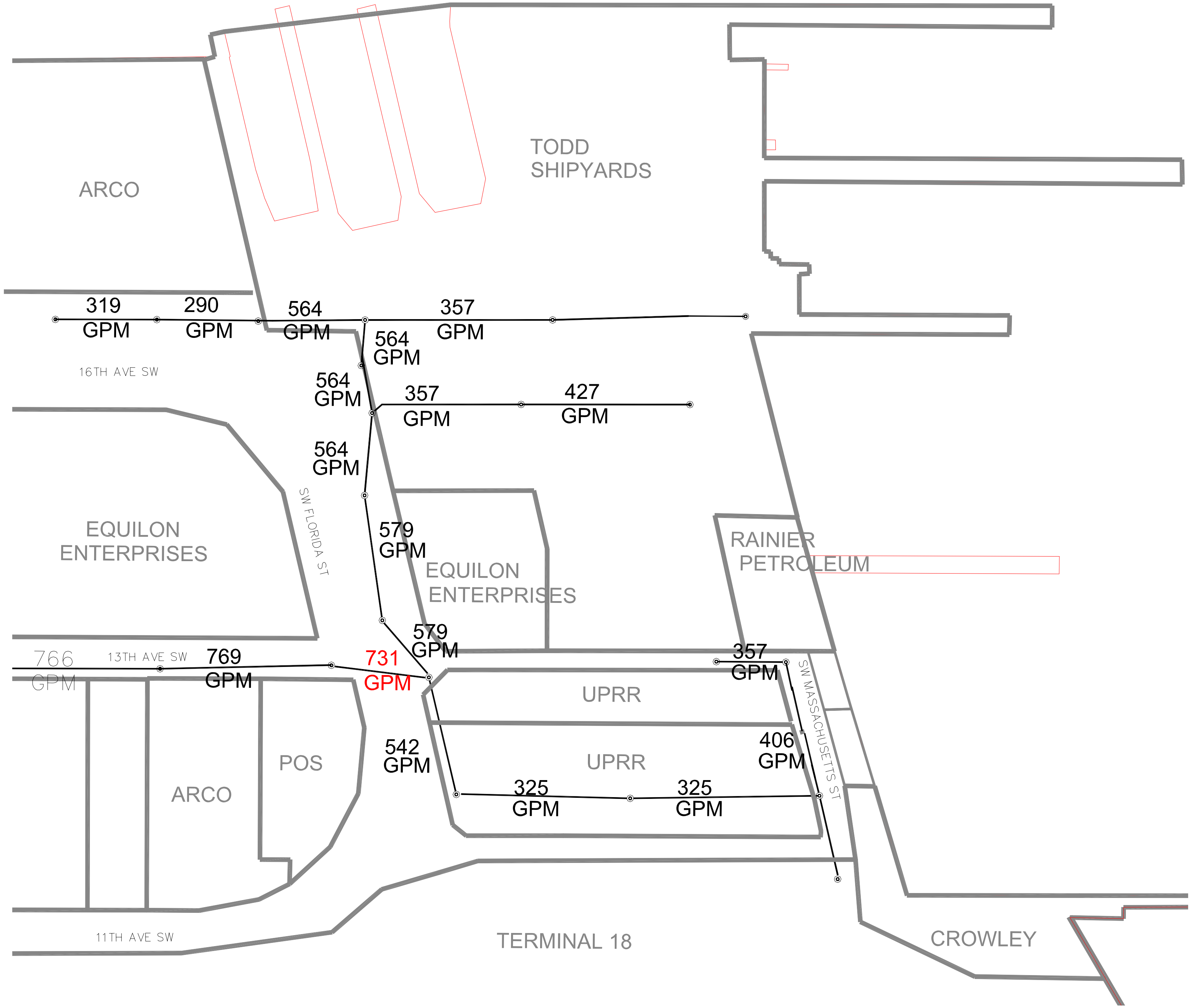
- Highly automated sandfilter system was chosen after extensive cost benefit analysis indicated that it provided best value overall in terms of capital and lifecycle costs
- Sandfilter system was oversized at 500 gpm to account for future requirements to process stormwater

STORMWATER – Further Upgrades Required

- NPDES requirements for stormwater are based on a 10 yr storm event
- Sanitary Sewer determined to be only viable discharge point for both Industrial Stormwater (land side) and Dockwater
  - Discharge Rate restricted by local sewer line capacity

2nd Round of Upgrades

- The 10 yr storm event was conservatively applied to dockwater as well as to industrial land areas within Todd Shipyards
  - Large impact to holding and transfer systems capacities
  - Filter system capacity determined to be satisfactory
- Stormwater discharge to surrounding waters deemed infeasible due to extremely restrictive limits on Copper (4.8 ppb)
- Stormwater discharge rates from land and docks are severely restricted by Public sewer system line capacities



TODD
SHIPYARDS
ARCO
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GPM
290
GPM
564
GPM
357
GPM
564
GPM
16TH AVE SW
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357
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427
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EQUILON
ENTERPRISES
SW FLORIDA ST
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RAINIER
PETROLEUM
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13TH AVE SW
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UPRR
SW MASSACHUSETTS ST
POS
542
GPM
UPRR
406
GPM
ARCO
325
GPM
325
GPM
11TH AVE SW
TERMINAL 18
CROWLEY

Issues with Stormwater on docks

- There were no real options for dockwater, sanitary sewer was deemed the only reasonable discharge point.
- Existing sandfilter system had performed well (no exceedences up to this point)
- Holding capacity & dock to filter system transfer system capacity woefully undersized

Options

- Increase holding capacity on dock
- Increase dock-to-filter transfer capacity
- Increase filter flowrate capacity
- Increase filter system feed tank holding capacity
- Combine dockwater with industrial (land) stormwater system

Design Decisions

- Keep dockwater and industrial (land side) stormwater separate
- dockwater discharge takes priority over Industrial stormwater discharge

Impacts to Dockwater

- Increase the transfer capacity vice on dock holding capacity
- Increase the dockwater holding capacity upstream of filter system
- Size of holding capacity developed in conjuction with Industrial Stormwater system

Transfer System Resizing

- Transfer capacity was worked out for each dock based on a 10-yr peak storm event combined with max process water flows and existing sump size
- System designed to accommodate three drydocks
- 10 yr peak storm event utilized the Santa Barbara hydrograph with 3.1 inches of rain. This model resulted in peak flows as follows:
  - DD #1 386 gpm max
  - DD#x 672 gpm max (future replacement for DD #2)
  - DD#3 838 gpm max

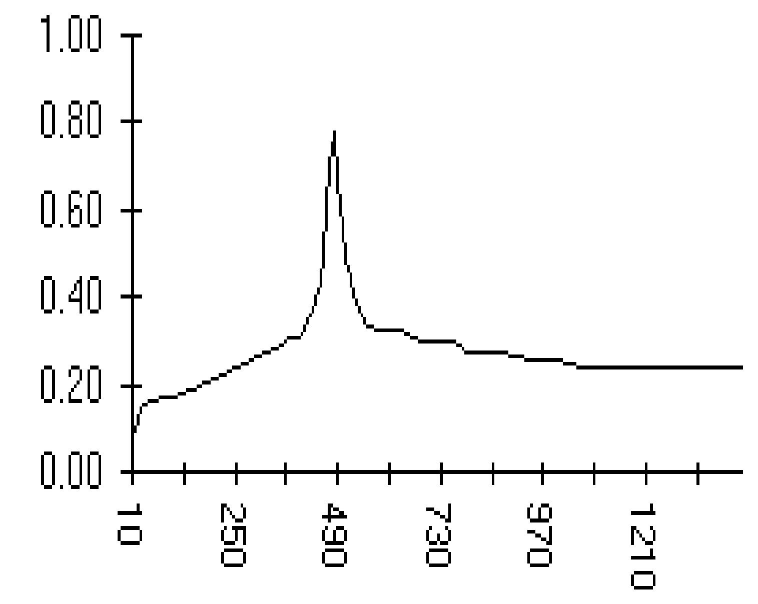
Santa Barbara Urban Hydrograph Calculations

Project: **Todd Shipyard**

Runoff in cfs vs. Storm Duration in minutes

Area:	2.58	acres	based on pontoon deck area (803x140)
Pt:	3.1	inches, (total rainfall for 10 yr., 24-hour storm)	
dt:	10	minutes	
Tc:	16	minutes	

Pervious Area		**Impervious Area**		**Weighted Parcel**	
Area, ac.	0	Area	2.58	Area	2.58
CN	70	CN	98	CN	98
S	4.29	S	0.20	S	0.20
0.2S	0.86	0.2S	0.04	0.2S	0.04



Total Runoff Volume : 0.31 million gallons

Filter System Holding Tank

- The filter system holding tank capacity was critical with regards to sizing the system discharge rate – Larger tankage = lower rate (and less impact on Industrial Stormwater discharge rate)
- The optimum tank size is roughly 200,000 gallons
- The optimum location was – NOT on land (waterfront area is prime real estate for production)

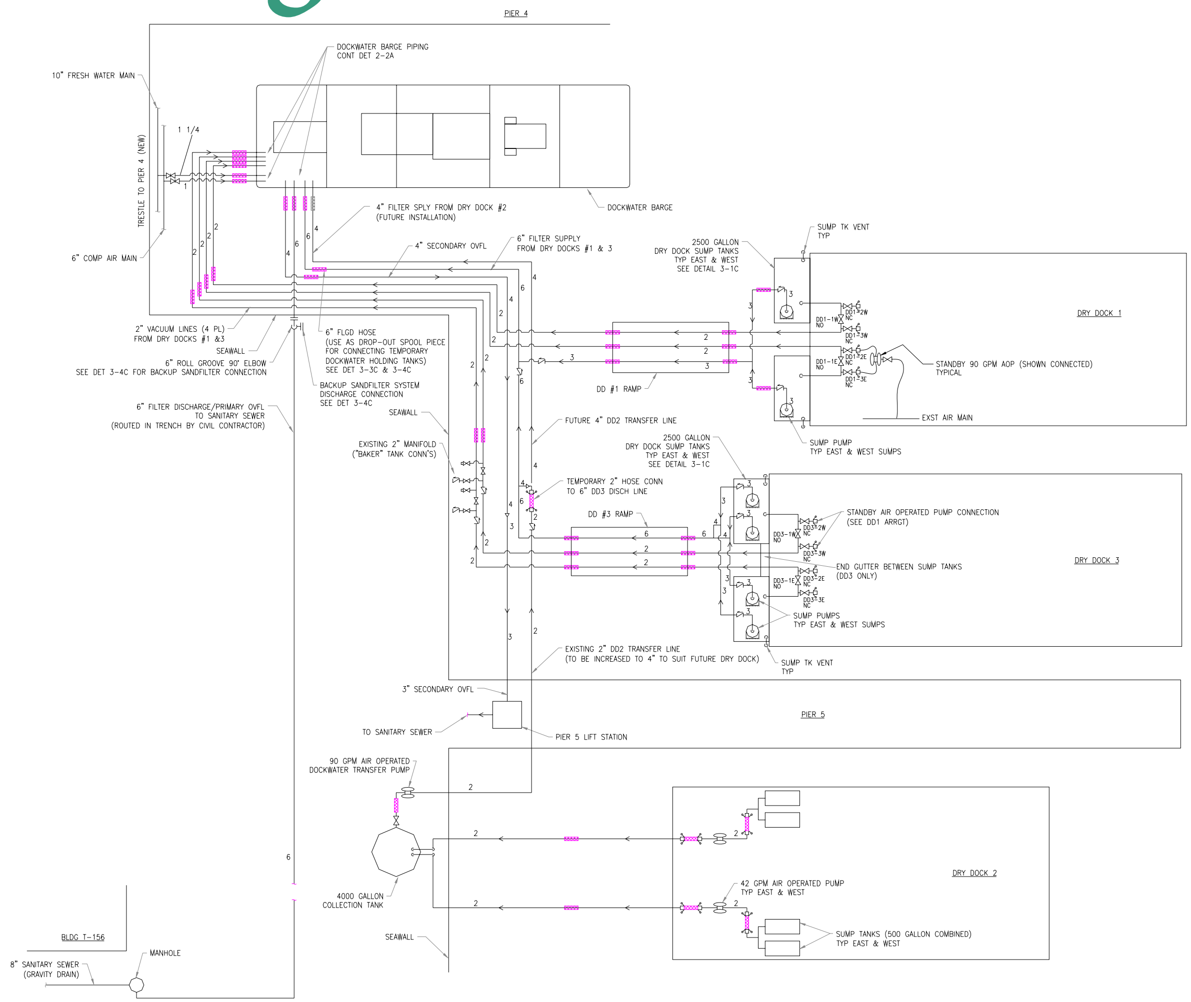
Dockwater Barge

- In order to achieve the large tankage and not impact land area, a barge was chosen for the Filter System holding tank
  - Converted a 188,000 gallon fuel barge
  - 120 ft long x 33 ft wide x 10 ft mean depth
- fits in basin between pier and drydock
- Sandfilter house was be set on barge

Filter System Discharge Rate

- The controls for the filter system are set to discharge at 230 gpm and automatically start when tank levels reach 20%
- Overflow pumps start automatically at preset tank levels
  - Primary overflow pump discharges at 220 gpm when tank levels reach 65% (interlocked with filter feed pump)
  - Secondary overflow pump discharges at 130 gpm when tank levels reach 90%

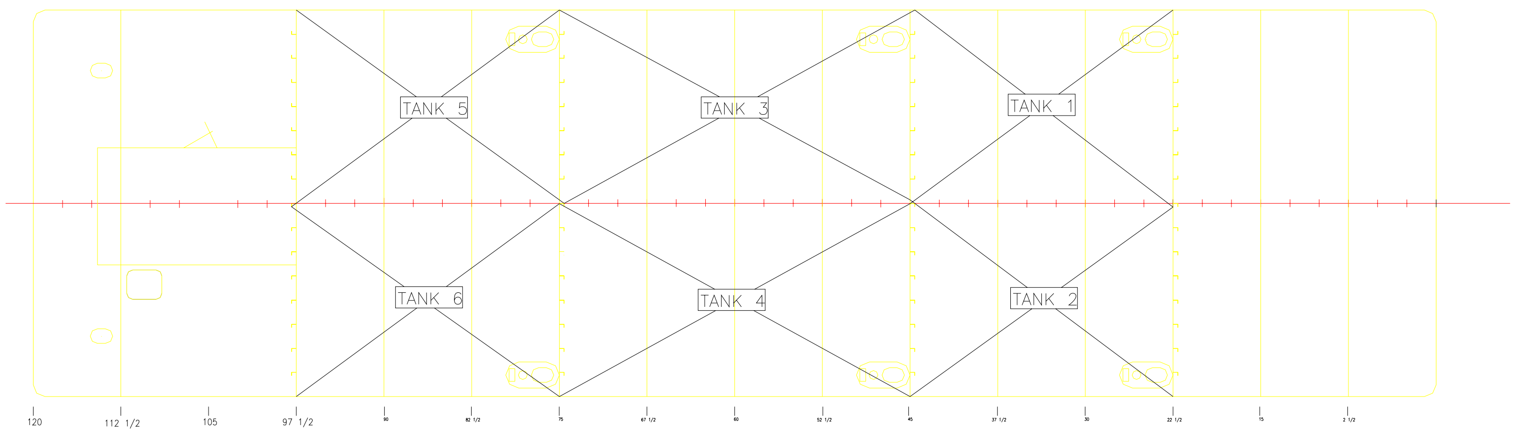
System Diagram



Issues with using a Barge

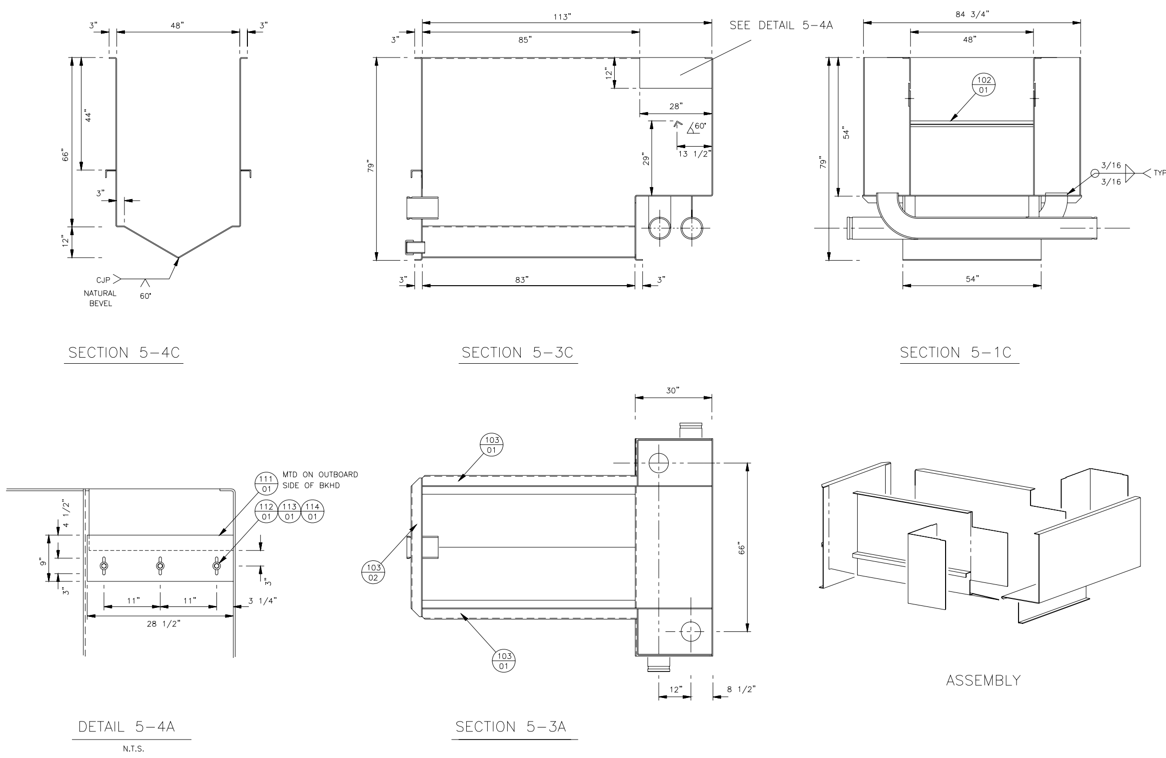
- MINIMIZE NUMBER OF TANKS
- LIST CONTROL (my favorite)
- TRIM CONTROL
- MOORING SYSTEM

Barge Tank Configuration



List Control

- Cross-connected Weirs



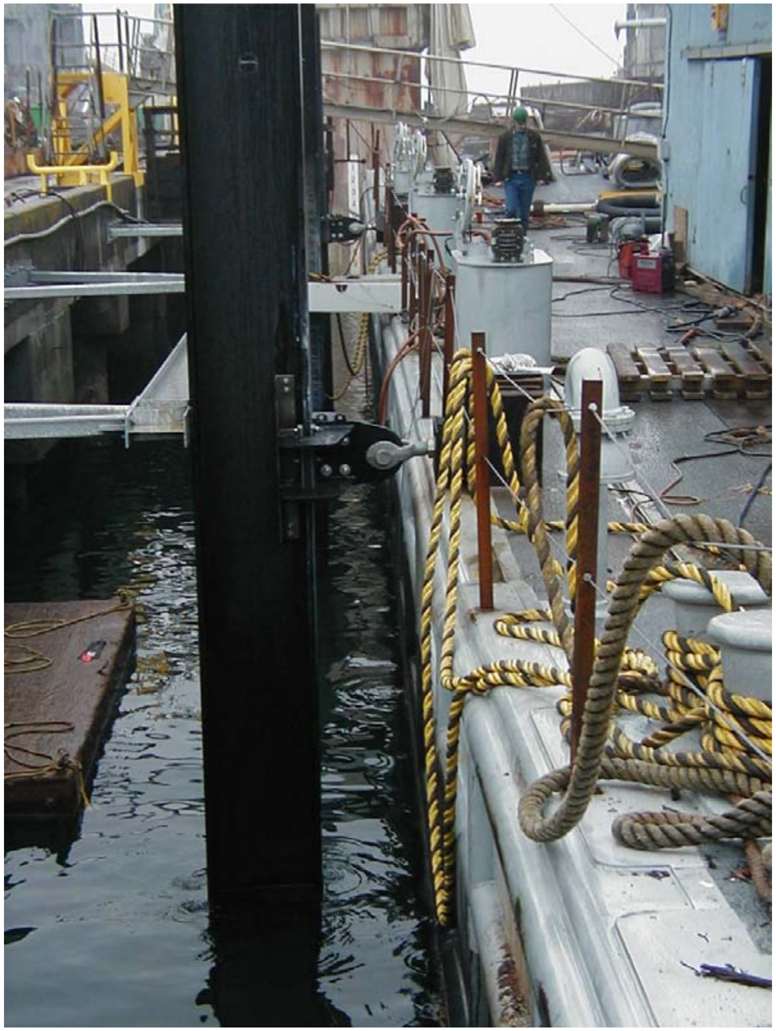
Trim Control

- The Trim of the dock is controlled in a very similar manner as list
  - Overflow bellmouths are located in both the forward and aft ends of each of the mid-body main tanks
  - The forward bellmouth overflows to the aft tank and the aft bellmouth overflows the forward tanks

Mooring System

- The mooring system of the barge is designed to accommodate a tide and freeboard range of over 21 feet while restricting the horizontal movement of the dock
- A spud and gripe system was used, similar to our drydock mooring systems

A Very Close Fit




U.S. ARMY
7
6
5
4

Current Status

- Current sandfilter system has experienced multiple copper and zinc exceedences over the last year
- Multiple issues contributed to exceedences (channeled beds, on/off nature of dockwater flows, motions of barge that prevents settling)
- End result is that the sandfilter itself is not adequate to ensure level of compliance required by Todd Shipyards and the local municipality

Future Upgrades

- Plan to install an Electro-Coagulation system in line with existing Sand-Filter system
  - Designed for a flow rate of 135 gpm
  - Install on land, in-line between docks and barge
  - Includes overflow pumps in a surge tank to handle storm events
  - System designed so that all of the dockwater goes through EC system approximately 90 percent of the time
  - Limit amount of sediment/coagulants that enter barge
  - Minimize load on sandfilter.
  - New system is being procured now and is expected to be in operation by March 06.