

Inedible
Not for Human
Consumption
800-964-0950

36-559 P

400

POLAR

Haulin'
Liquid
Chicken



INEDIBLE
49

652-531

Livingston

Livingston

Hydraulic Profiles in Wastewater Treatment Plants

Source

Syed Qasim, 1999. Wastewater Treatment Plants:
Planning, Design and Operation, 2nd Edition,
Technomic, Lancaster, PA, 1106 p.

Hydraulic Equations

- Energy and Continuity Equations
- Friction Head Losses – Hazen-Williams
 - $V = 1.318CR^{0.63}S^{0.54}$
 - $H_L = L \left[\frac{2.313}{CD^{2.63}} \right]^{1.85} Q^{1.85}$
- Minor Head Losses
 - $H_L = KQ^n$
- Open Channel Flow
 - Uniform flow with Manning Equation
- Weirs
 - Appropriate weir equation, may have multiple

Figure 21-1—cont'd

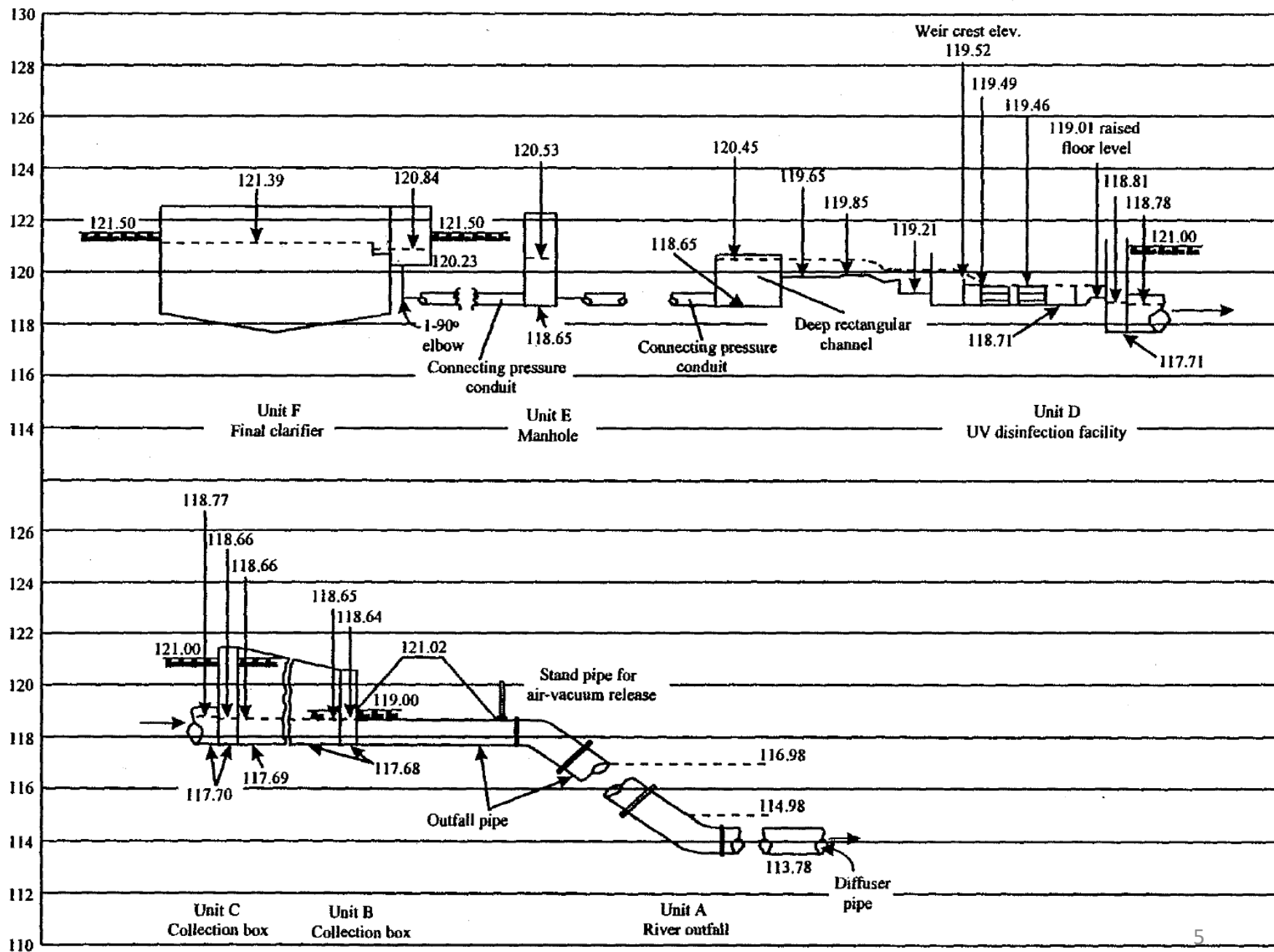
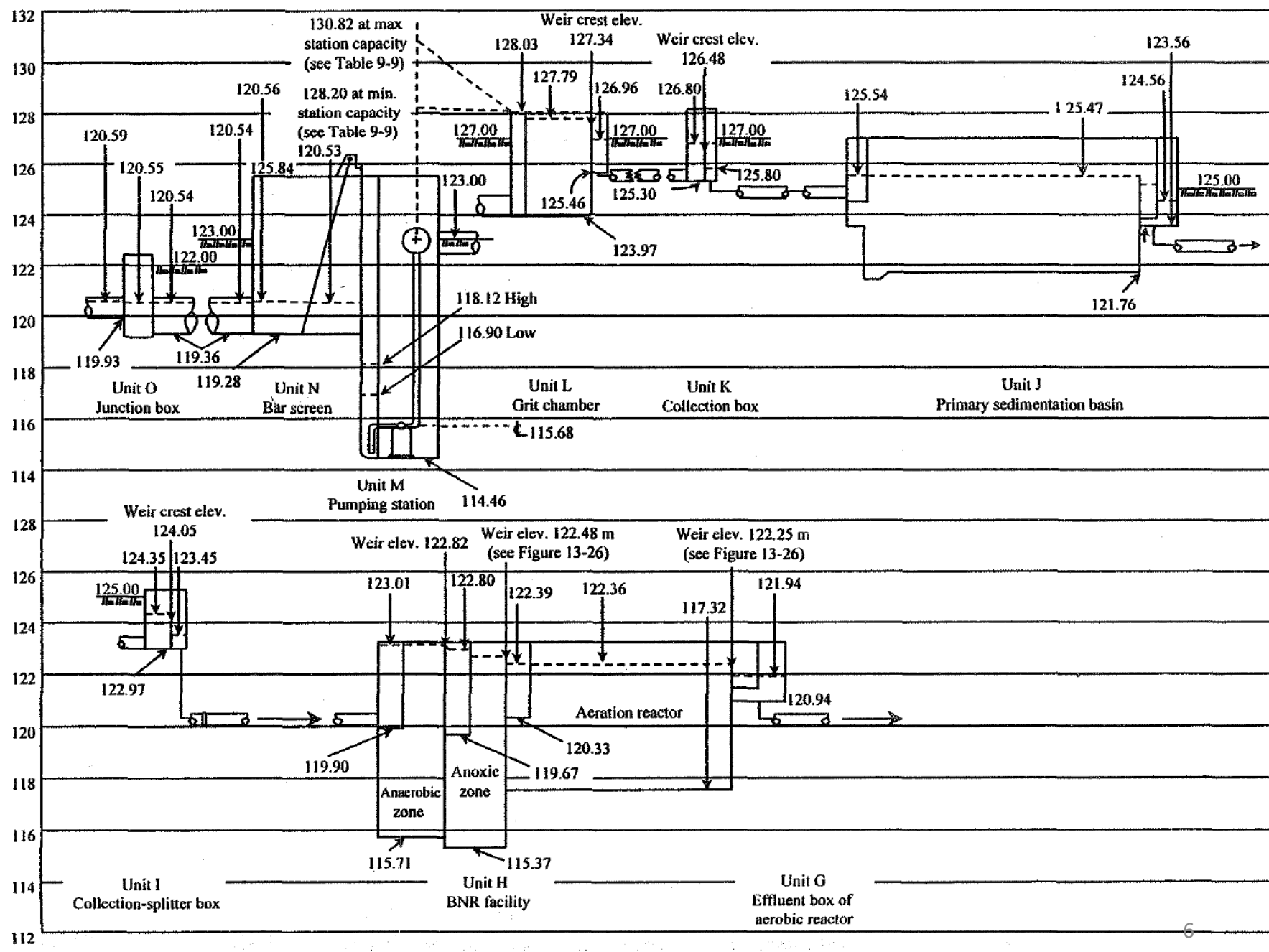
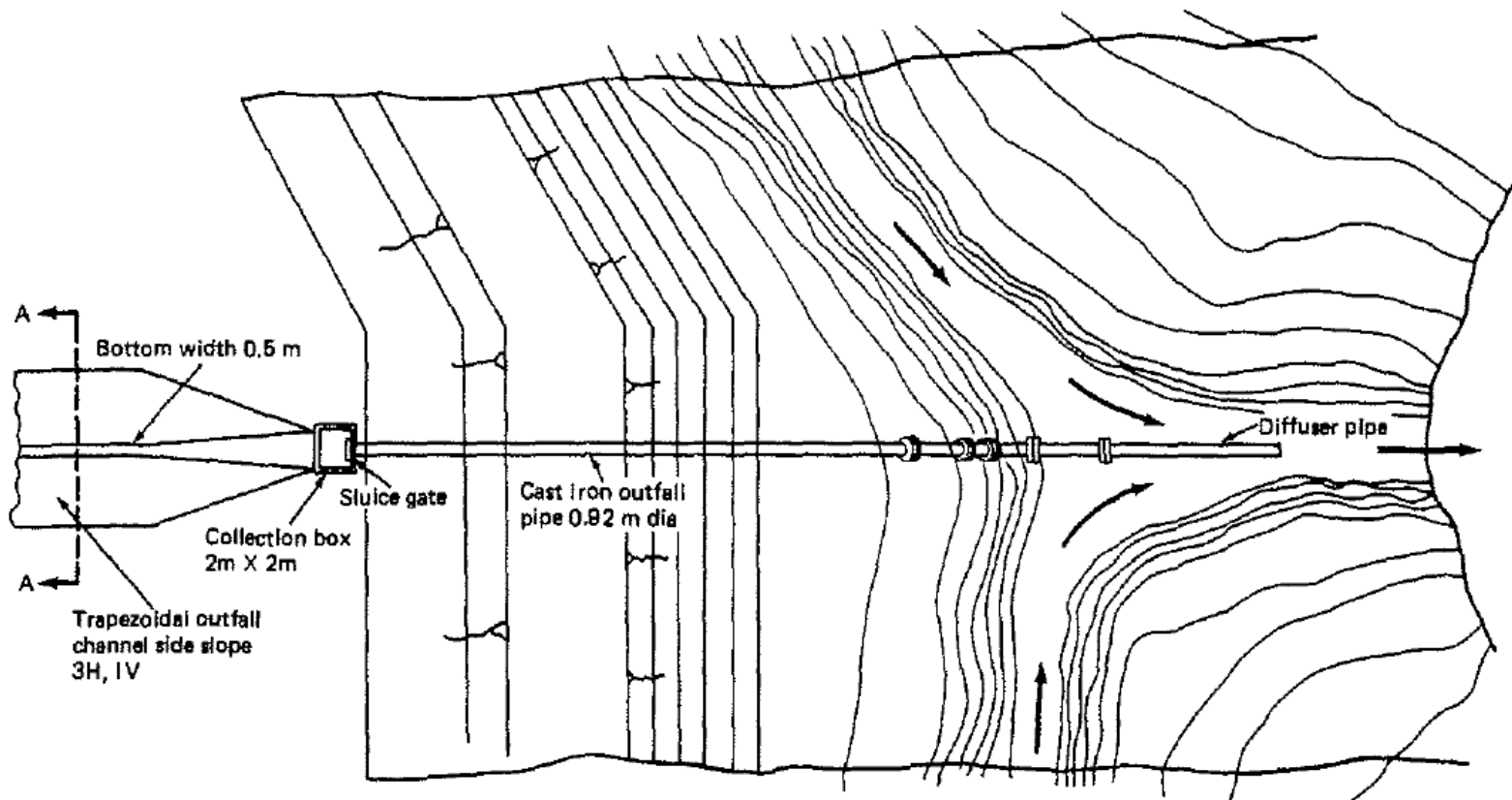
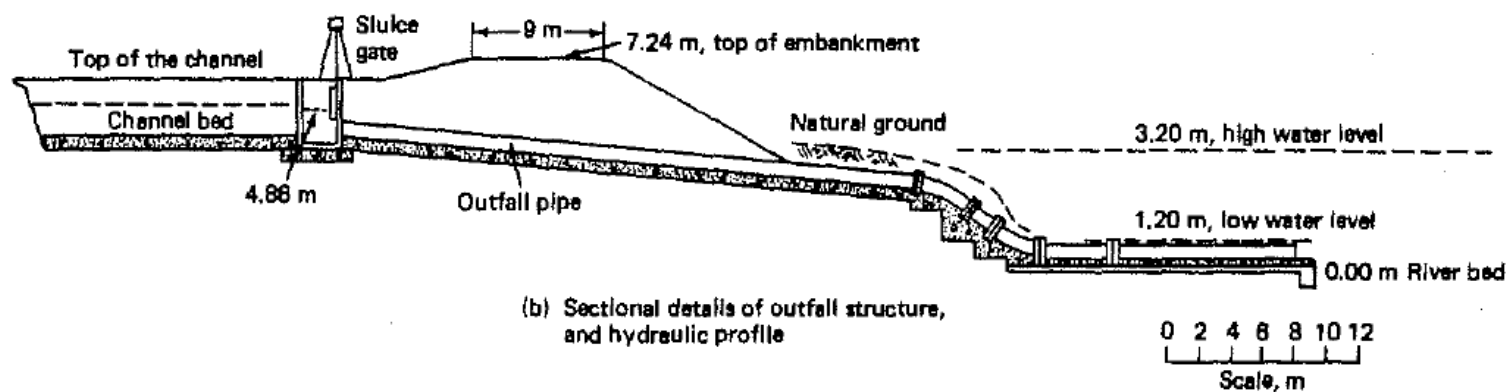


Figure 21-1 Hydraulic Profile through the Treatment Facility in the Design Example.





(a) Plan of outfall structure and receiving water



(b) Sectional details of outfall structure, and hydraulic profile

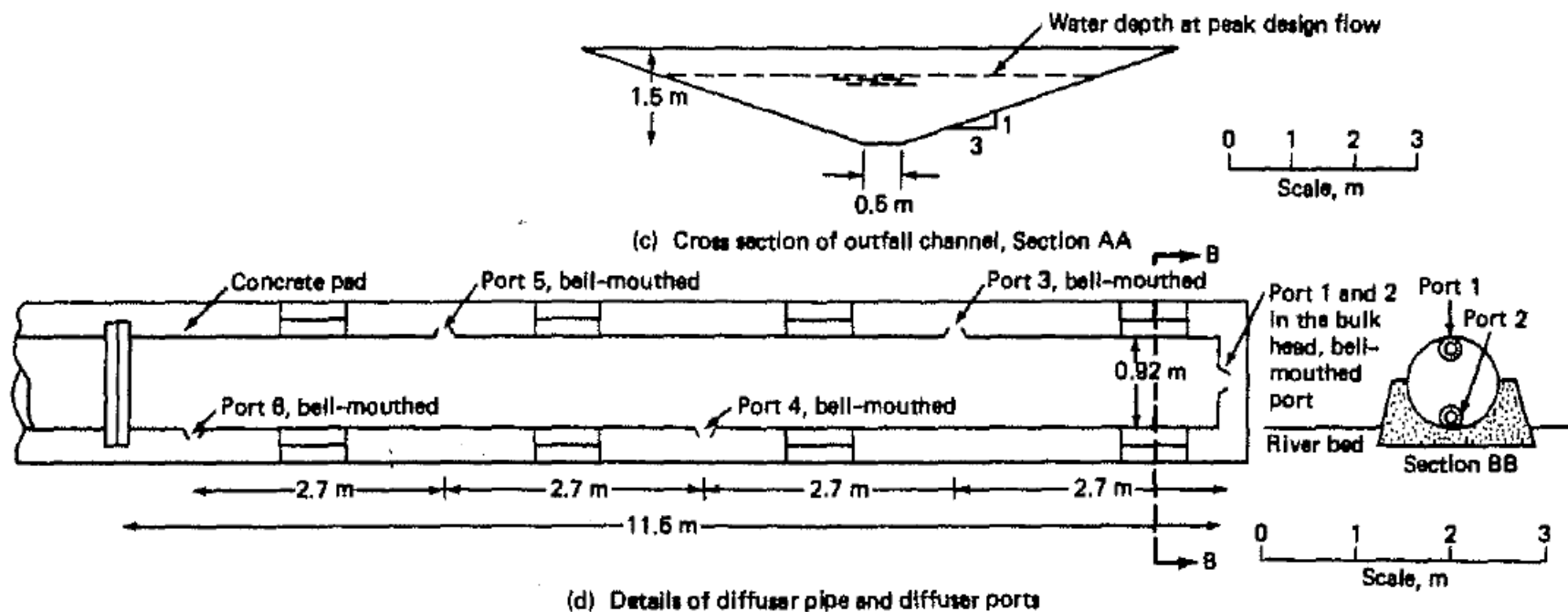


Figure 15-2 Details of Outfall Structure.

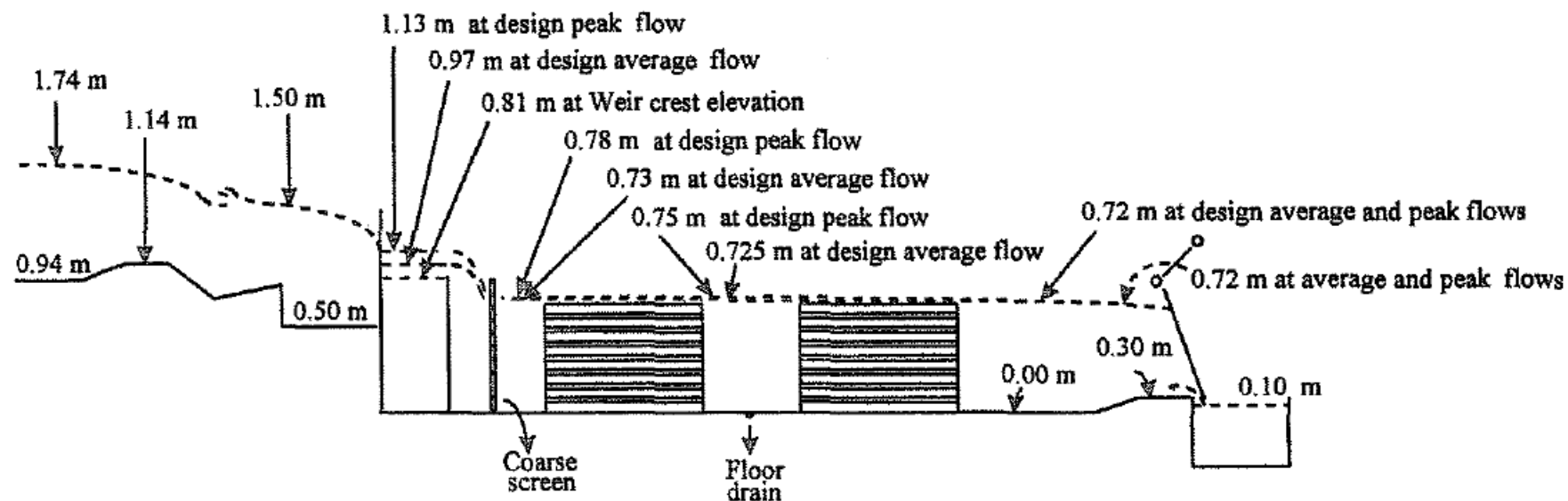
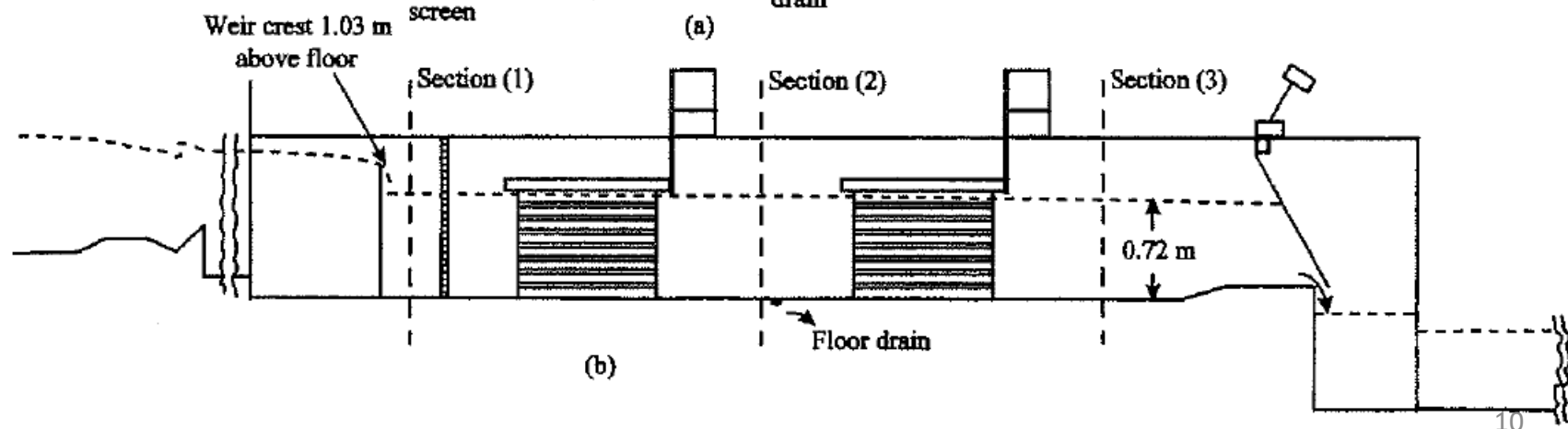
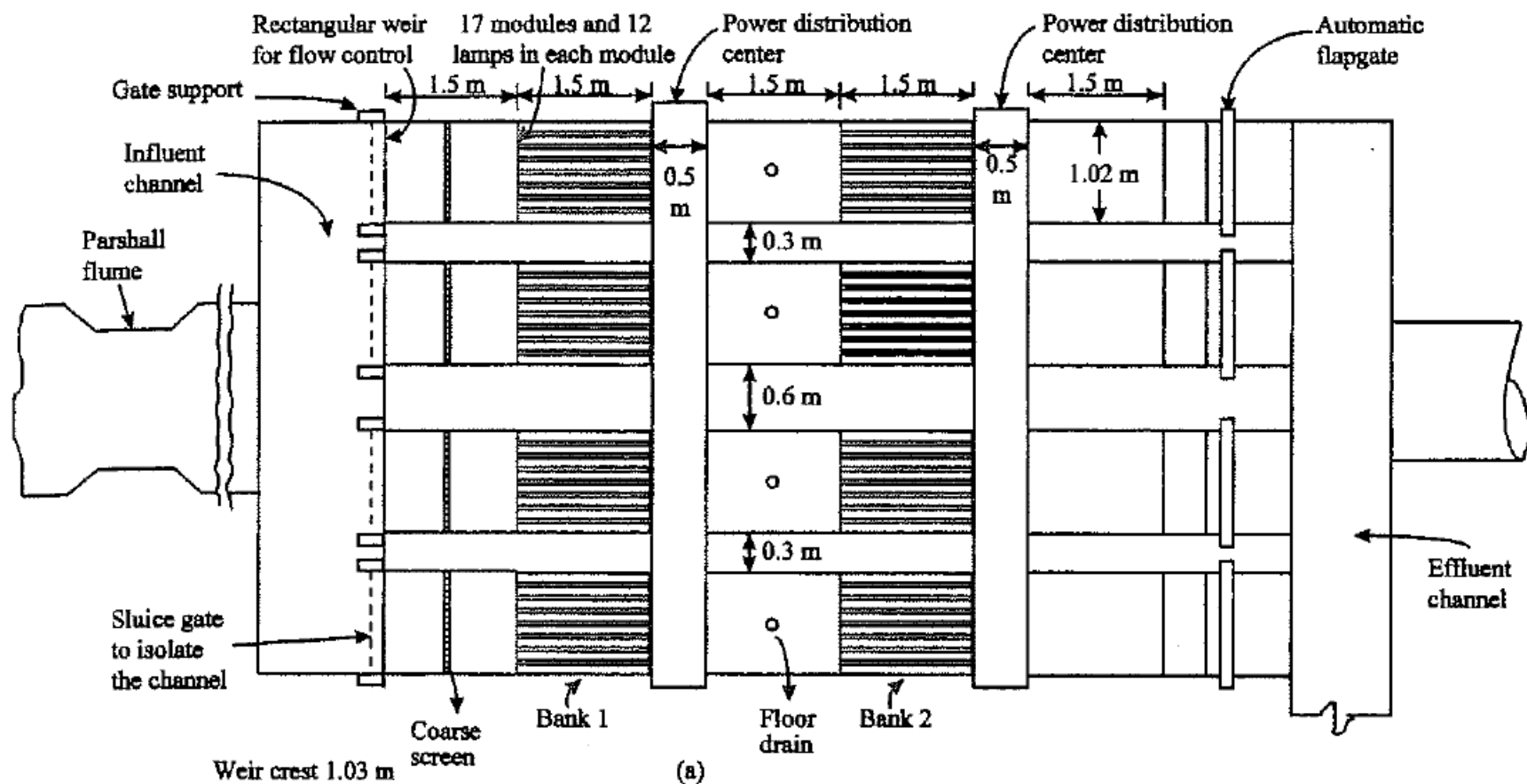
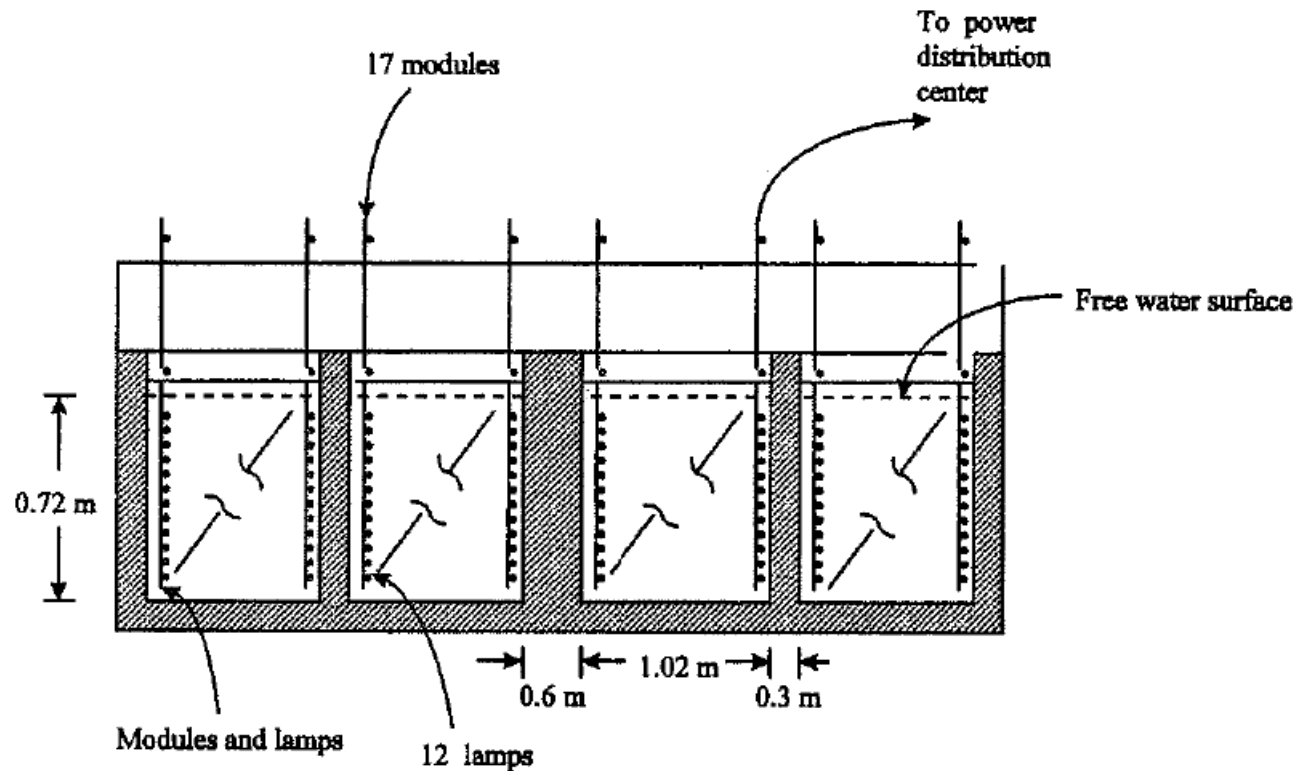


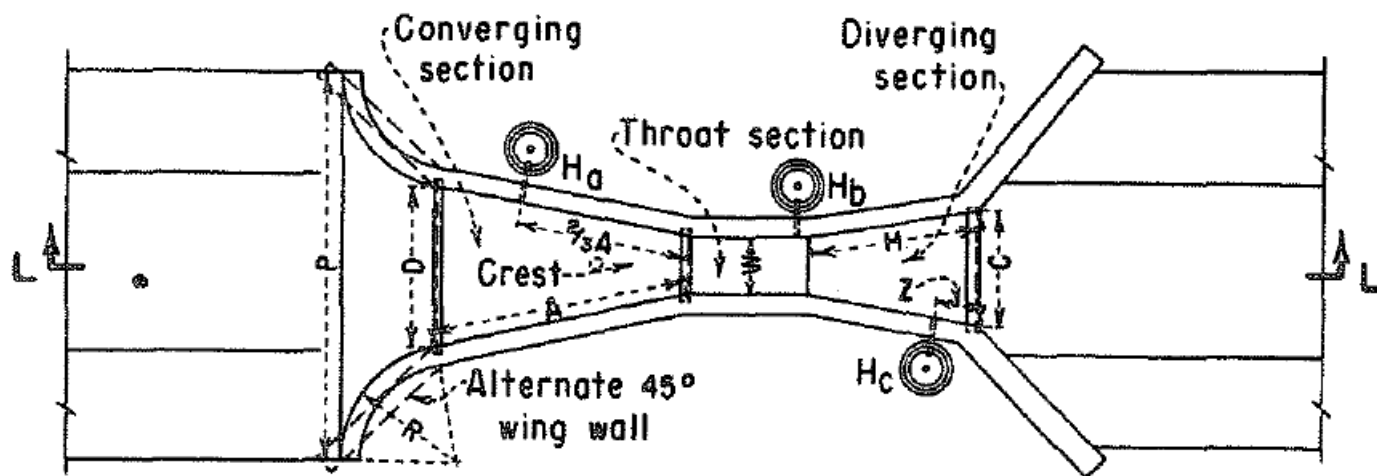
Figure 14-24 Hydraulic Profile Through the Parshall Flume and UV Disinfection Channel at Peak Hour Wet Weather Flow.





(c)

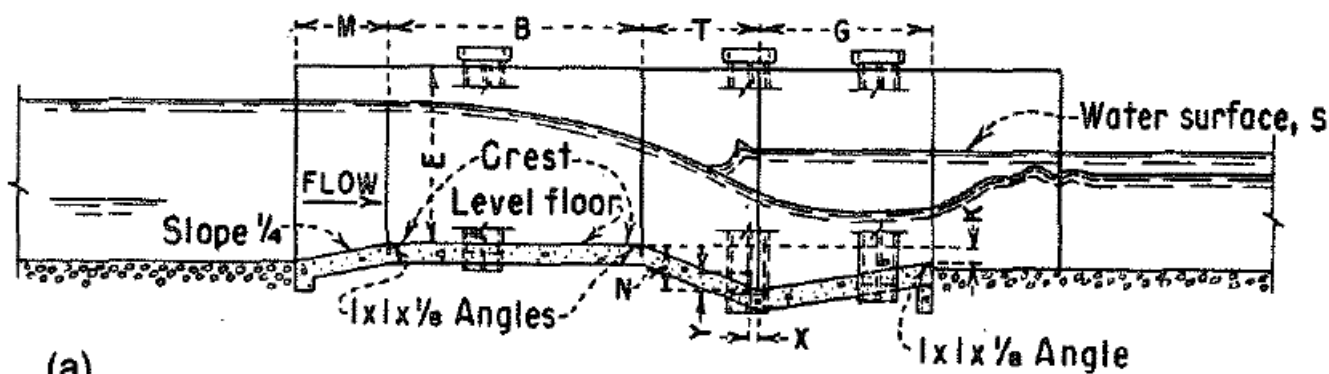
Figure 14-21 Design Details of the UV System: (a) plan, (b) longitudinal section, (c) cross section.



PLAN

Standard dimensions
of 1.22 m (4ft)
Parshall flume

W	1.22m
A	1.83m
B	1.79m
C	1.52m
D	1.94m
E	0.91m
T	0.61m
G	0.91m
H	-
K	0.08m
M	0.46m
N	0.23m
P	2.66m
R	0.61m
X	0.05m
Y	0.08m
Z	-
Capacity,min.	36.81l/s
Capacity,max.	1922.71l/s



(a)

SECTION L-L

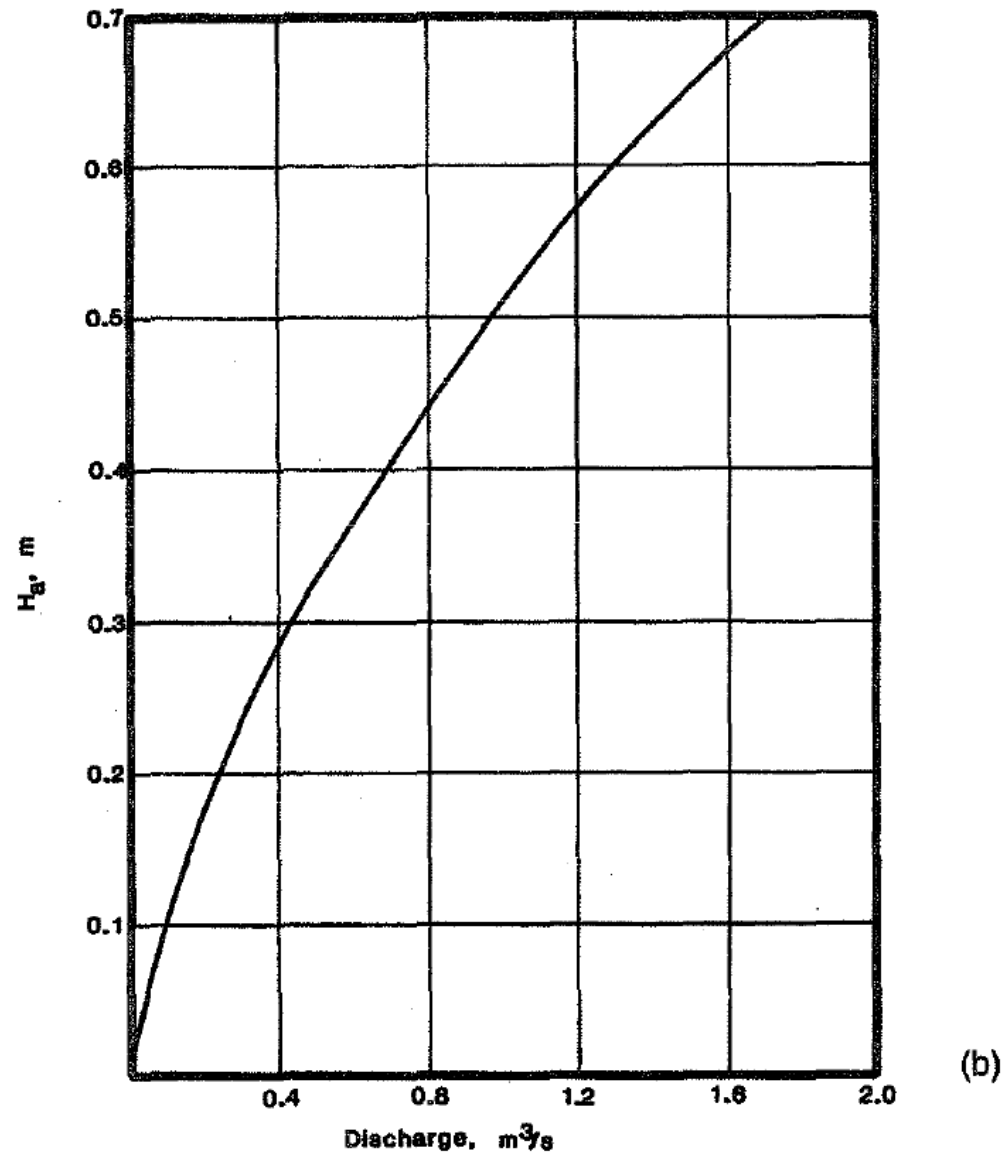


Figure 14-23 Design Details of Parshall Flume Used for Flow Measurement in the Design Example: (a) standard dimensions of Parshall flume (from Refs. 28 and 29); (b) calibration curve of 1.22 m (4 ft) Parshall flume.

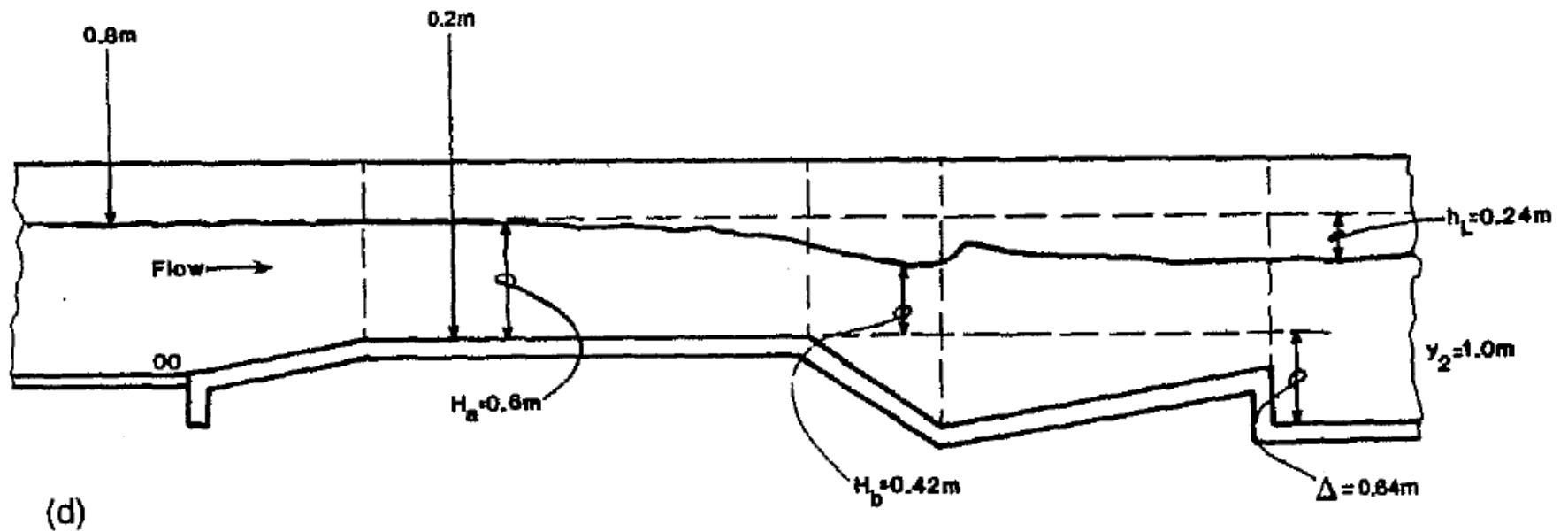
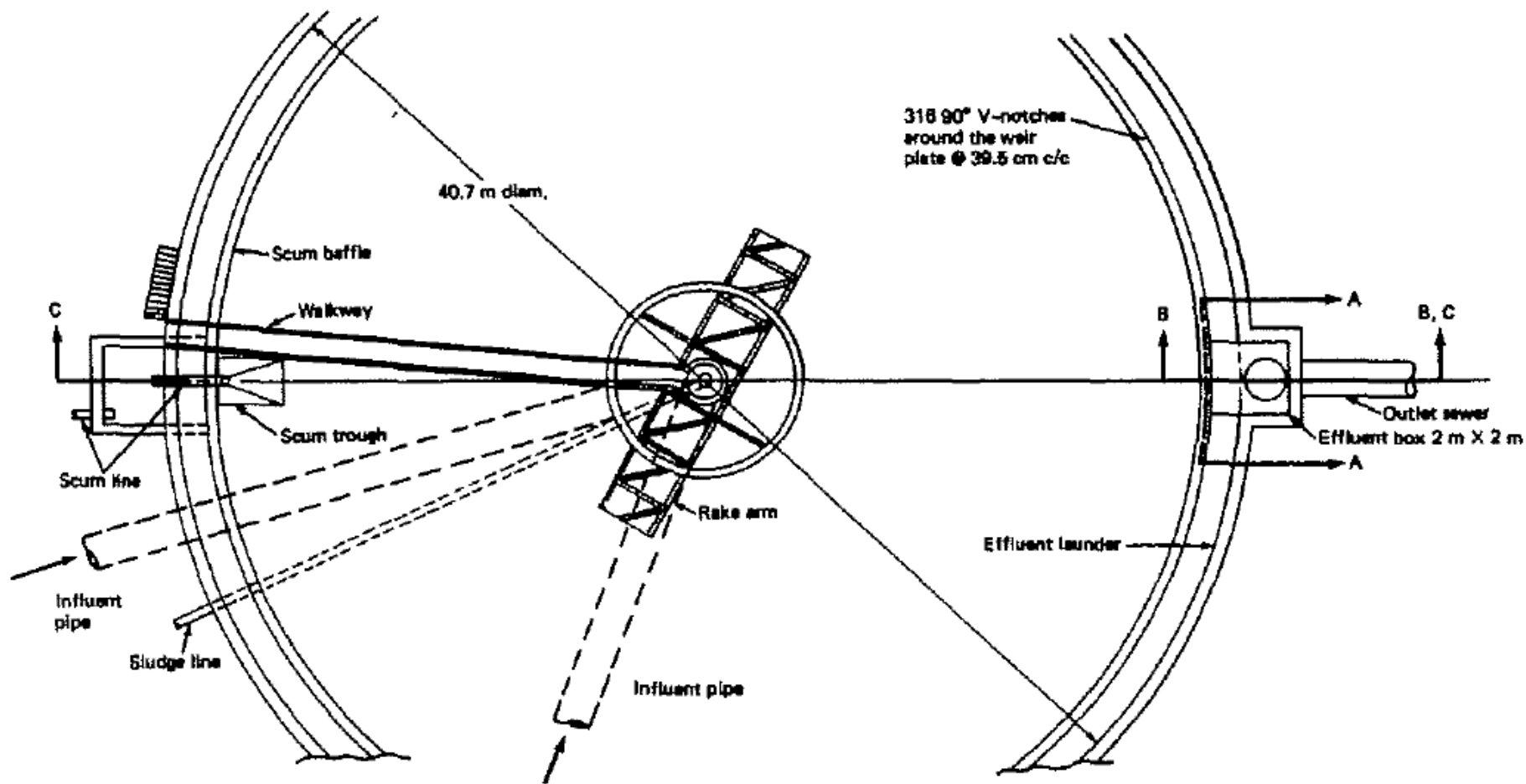


Figure 14-23—cont'd (c) head loss through Parshall flume, second-ft = ft^3/s . (from Refs. 28 and 29); and (d) water surface profile through Parshall flume at peak design flow.



(a) Plan view

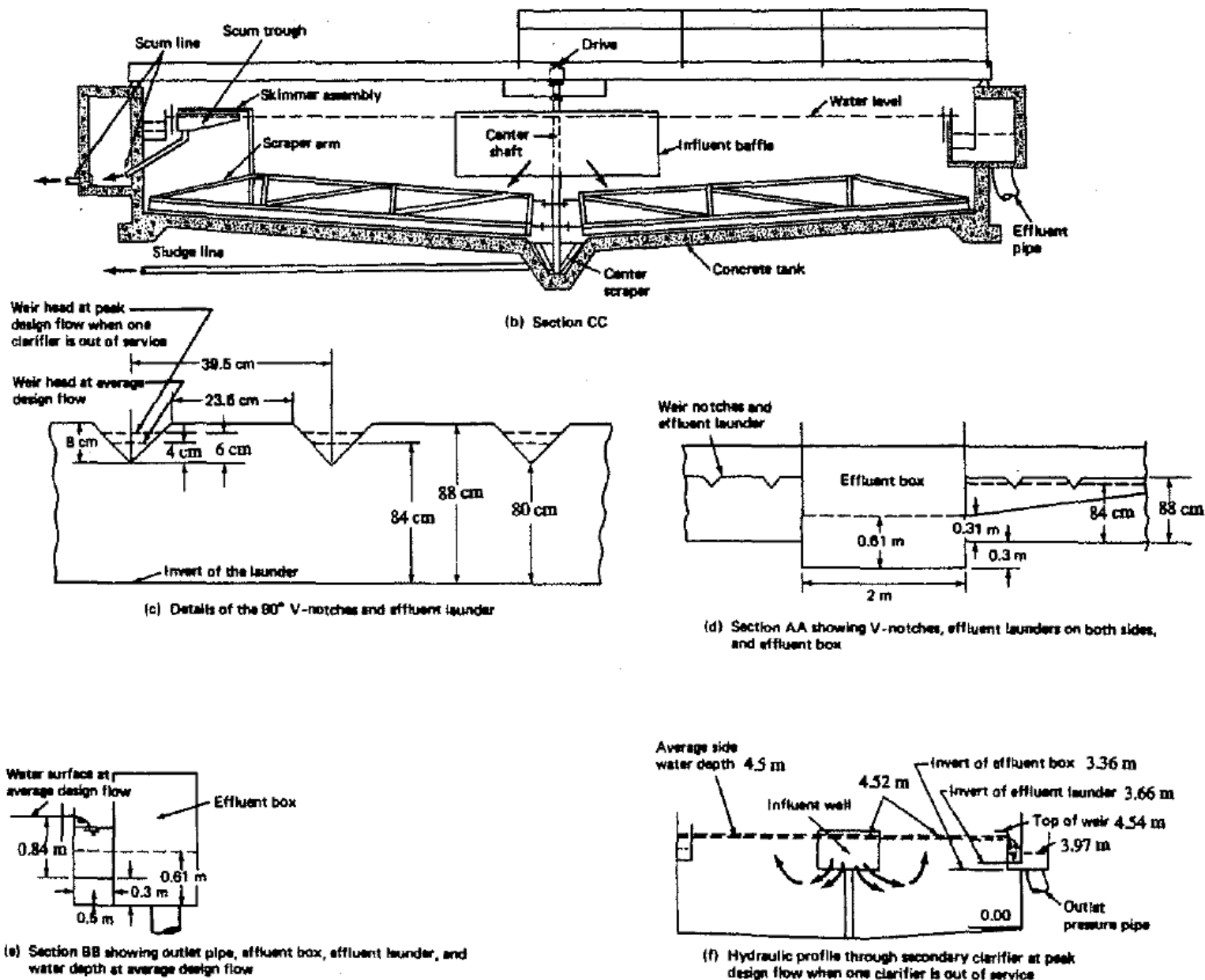


Figure 13-29 Design Details and Layout of Final Clarifier.

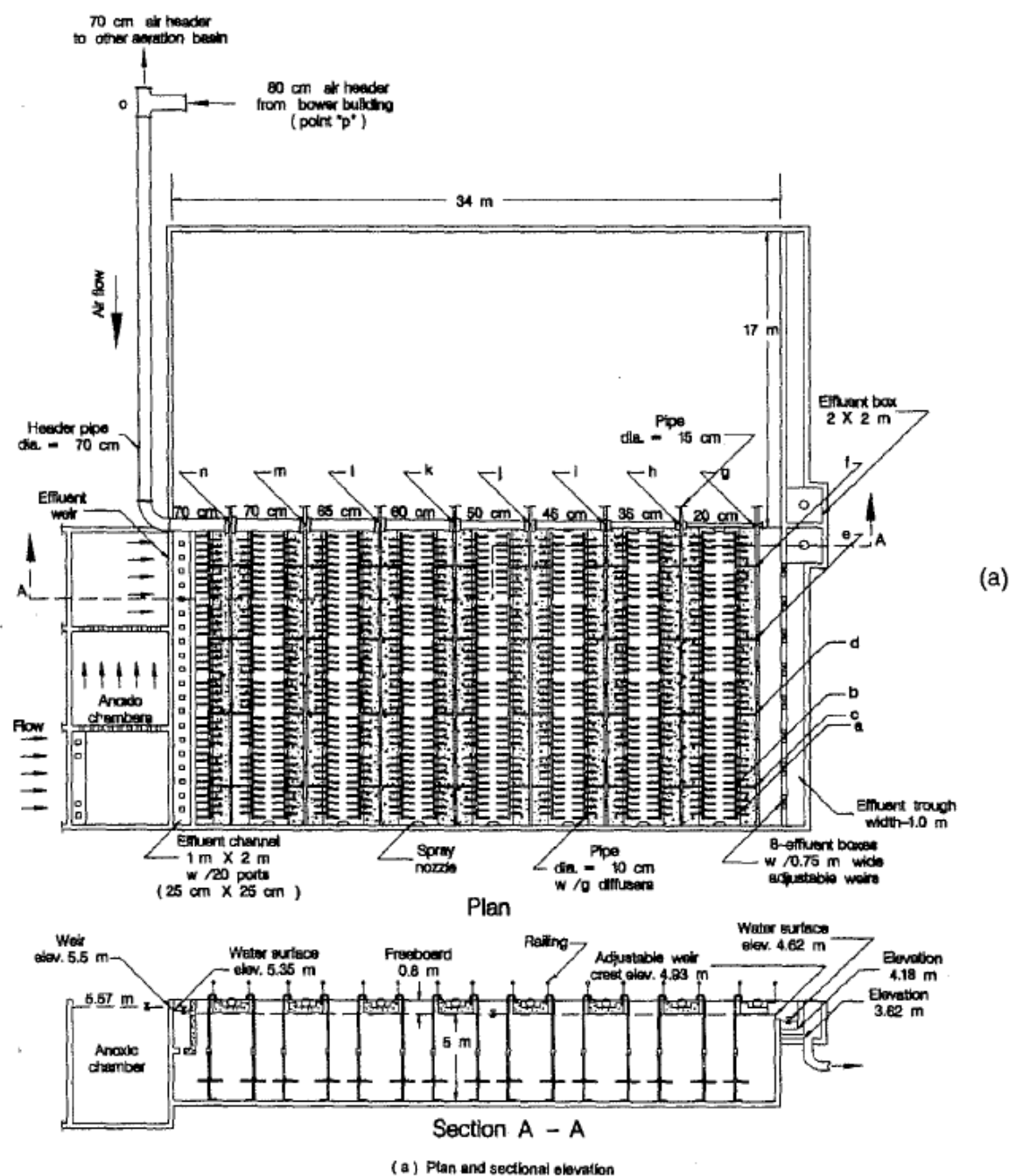


Figure 13-27 Design Details of Aeration Basin and Aeration System.

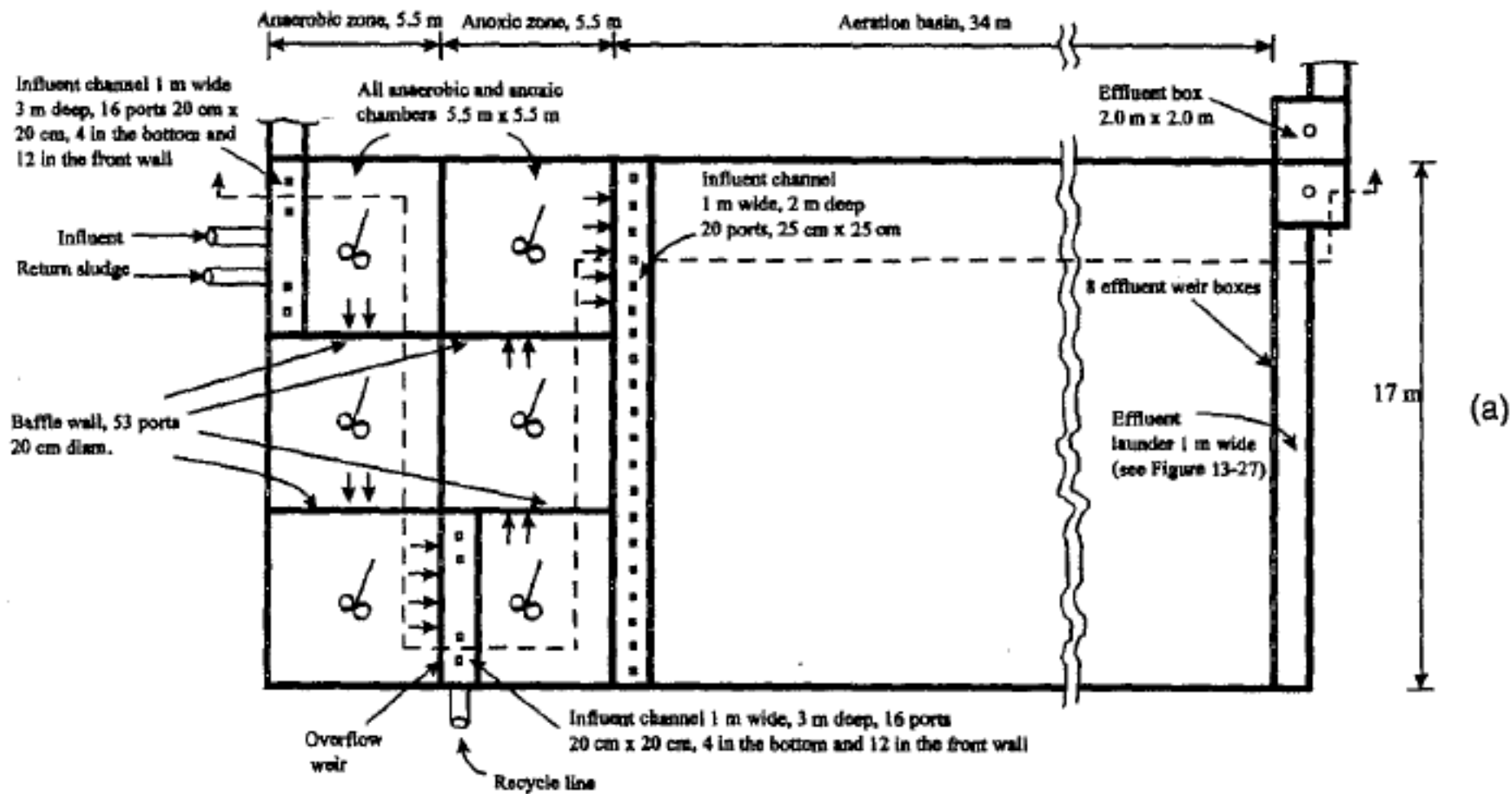


Figure 13-26 Design Details of BNR Facility: (a) plan.

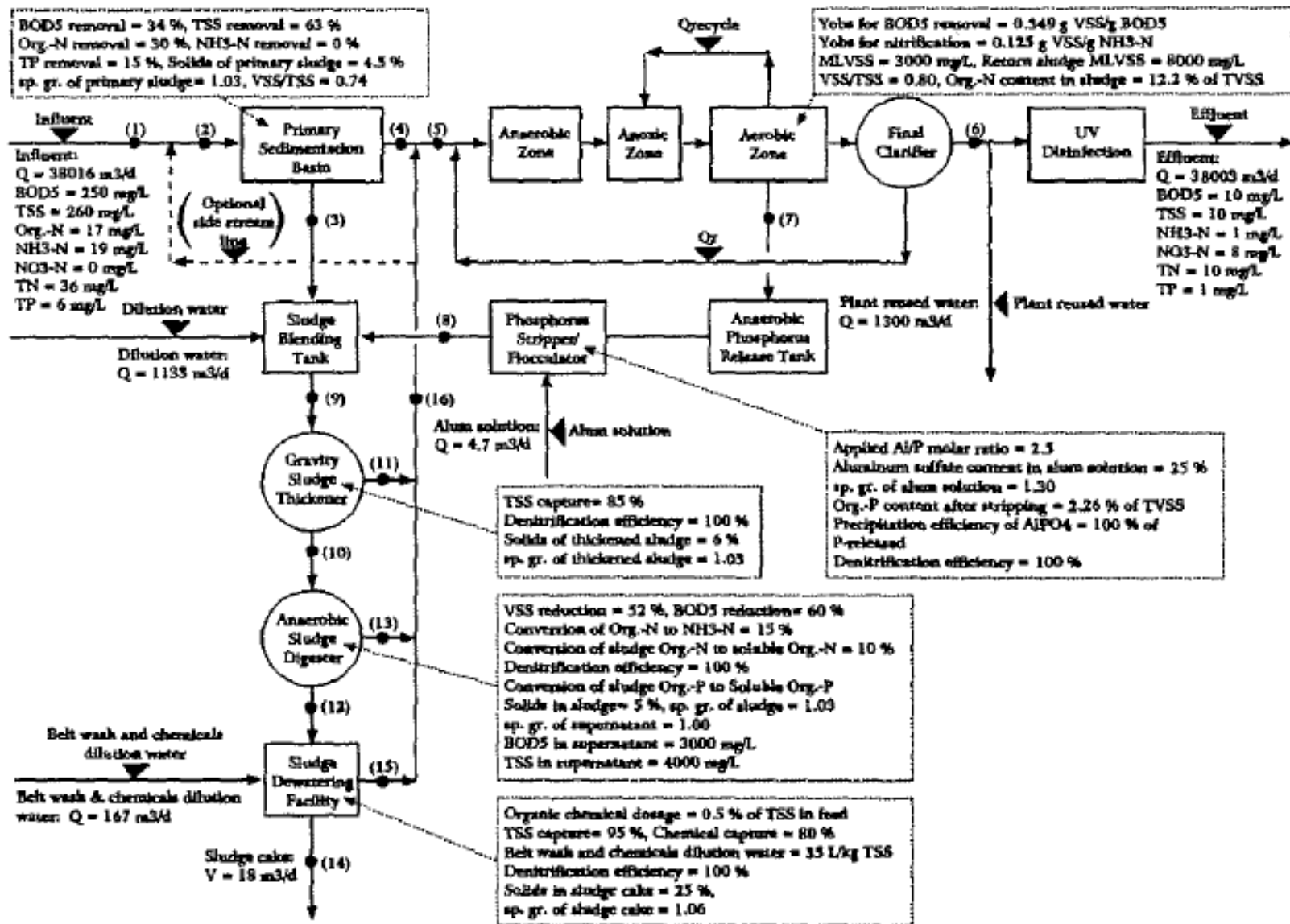


Figure 13-25 Stream Identification and Process Performance for Material Mass Balance Analysis.

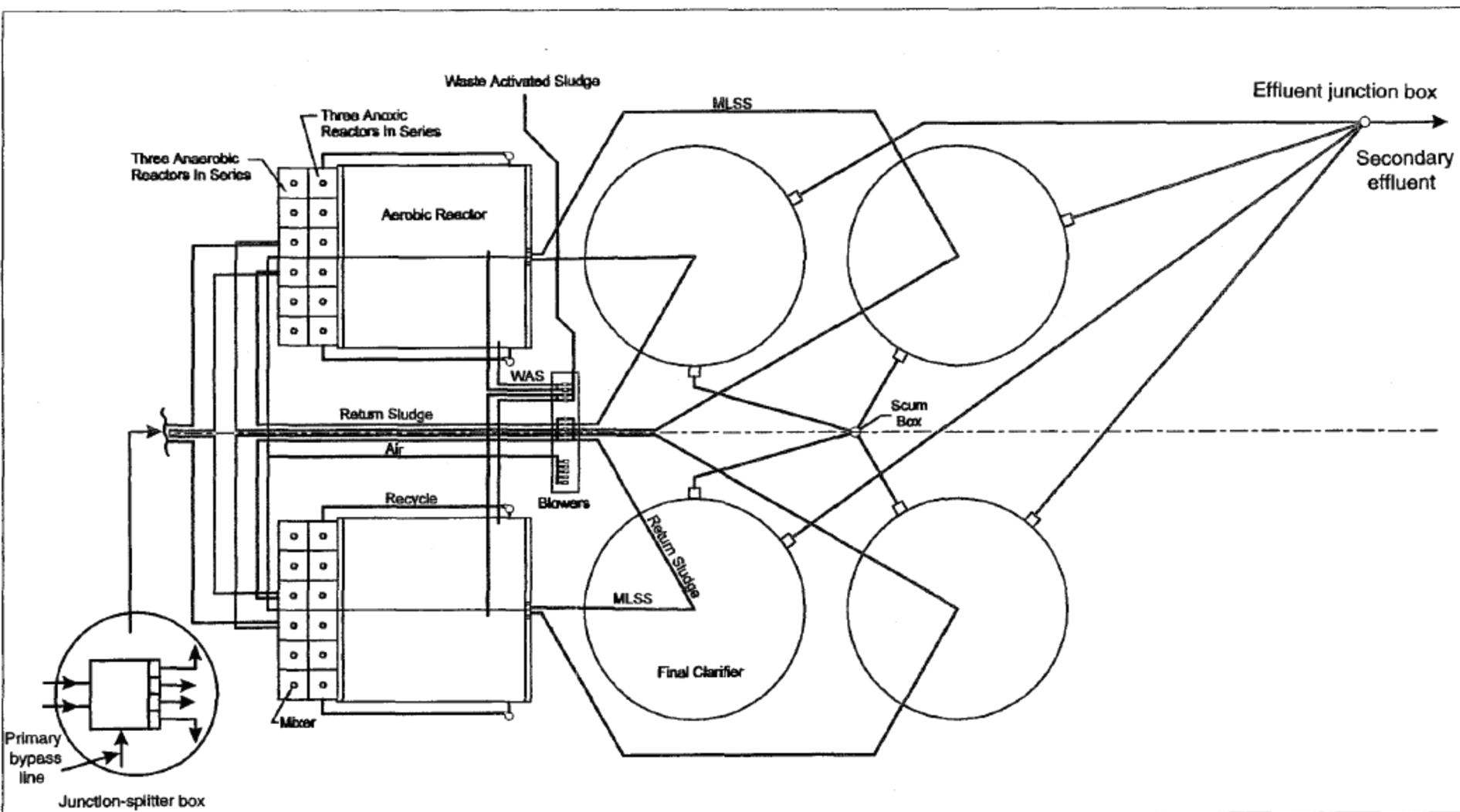


Figure 13-24 Schematic Flow and Piping Arrangement of Biological Nutrient Removal Facility.

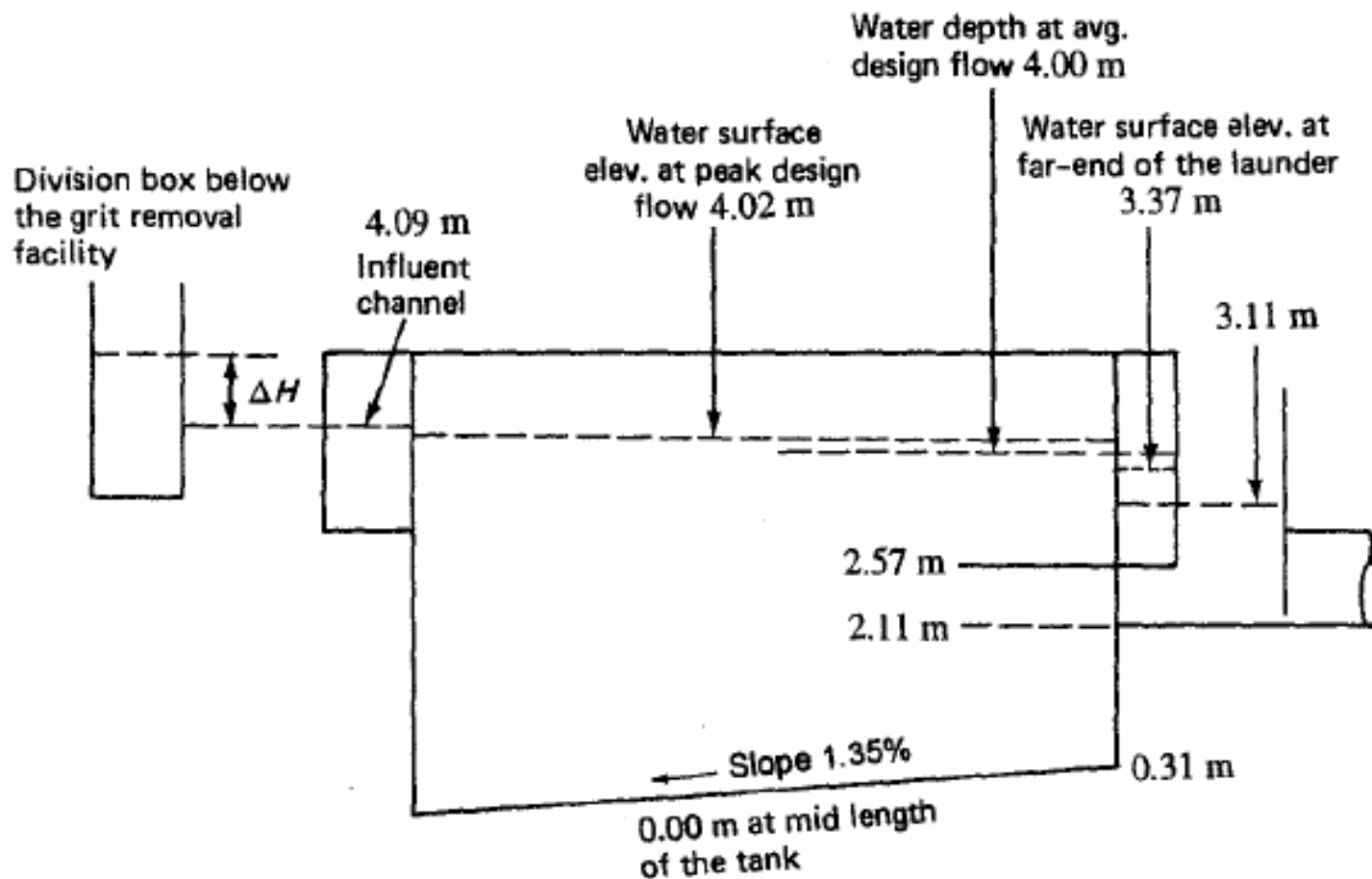
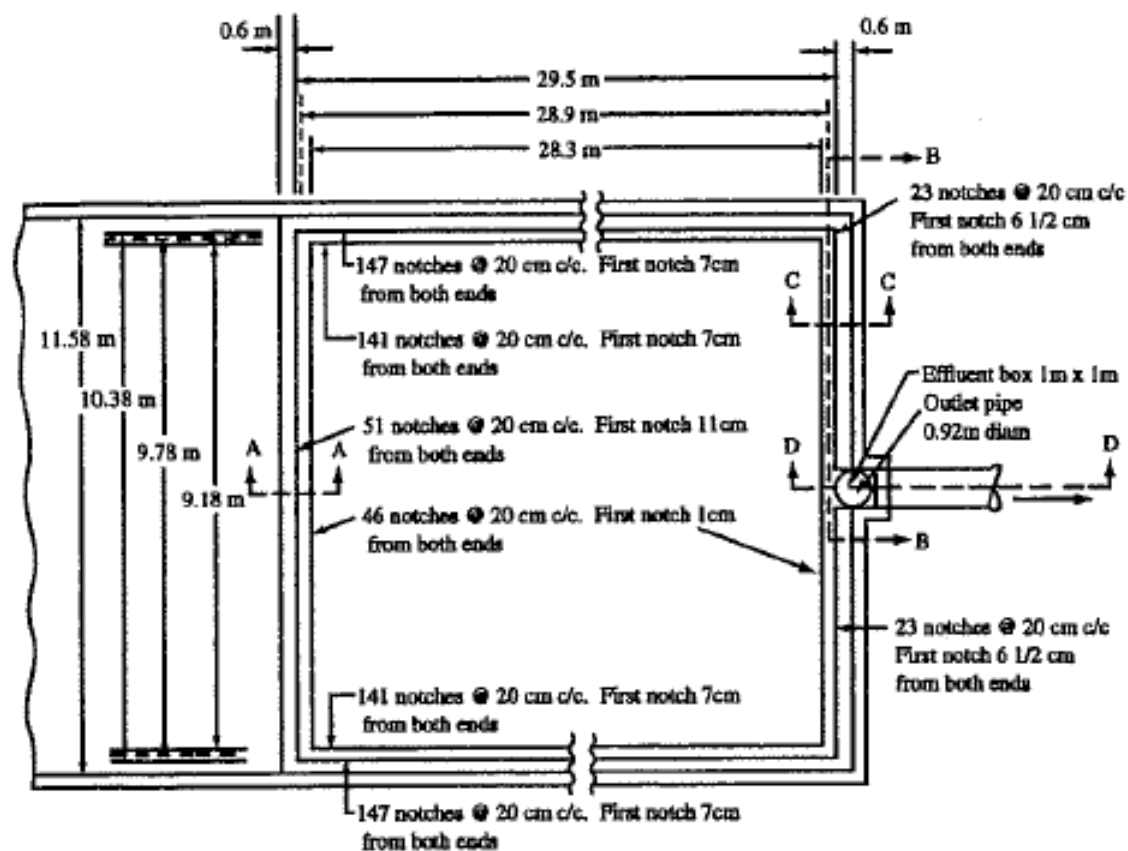
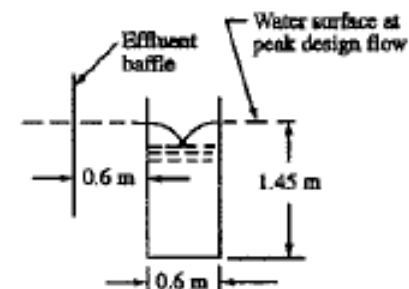


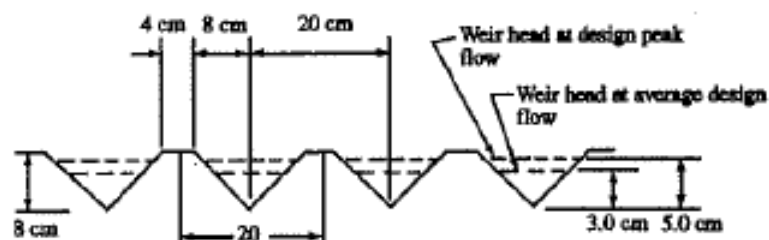
Figure 12-19 Hydraulic Profile Through Primary Sedimentation Basin at Peak Design Flow. (The hydraulic profile is prepared with respect to the assumed datum at the bottom of the basin at midlength.)



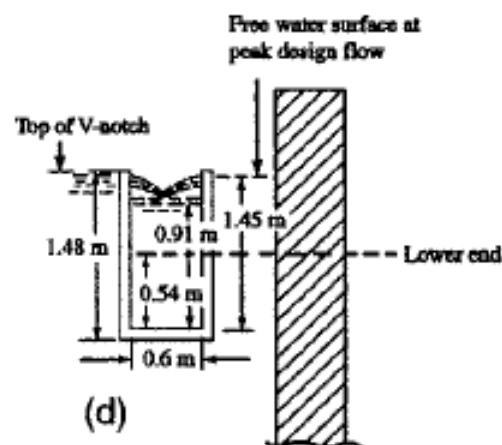
(a)



(b)



(c)



(d)

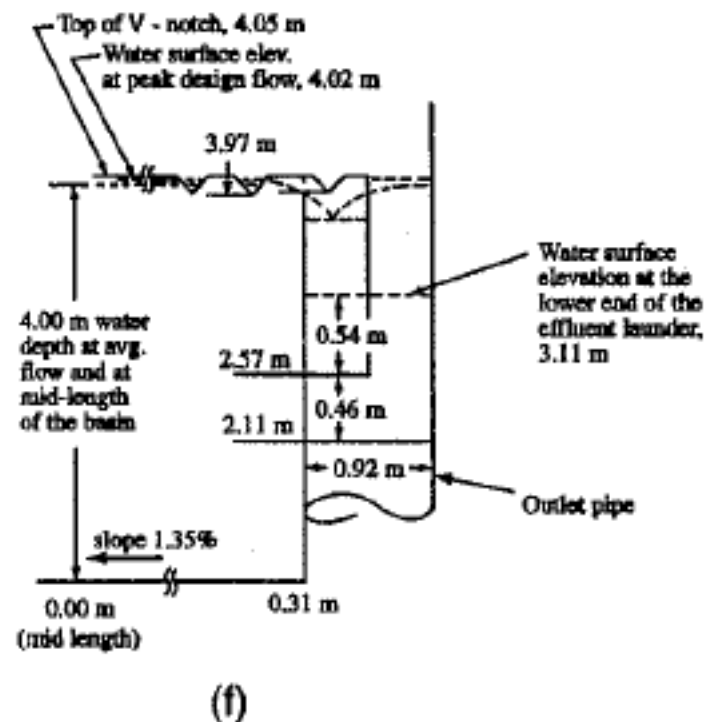
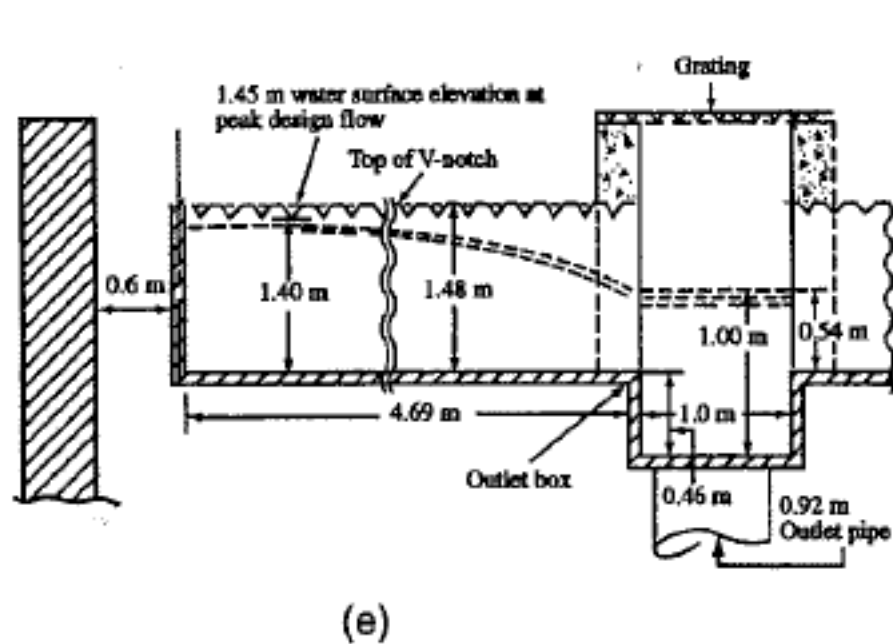


Figure 12-18 Weir Arrangement and Design Dimensions of the Effluent Structure: (a) plan view, weir arrangement; (b) section AA, weir trough (effluent launder) with weir notches on both sides; (c) details of the V-notches; (d) section CC, details of the effluent launder; (e) section BB, water surface profile in the effluent launder; and (f) section DD, details of the outlet channel. All Elevations Are with Respect to the Floor Level of the Basin at Midlength.

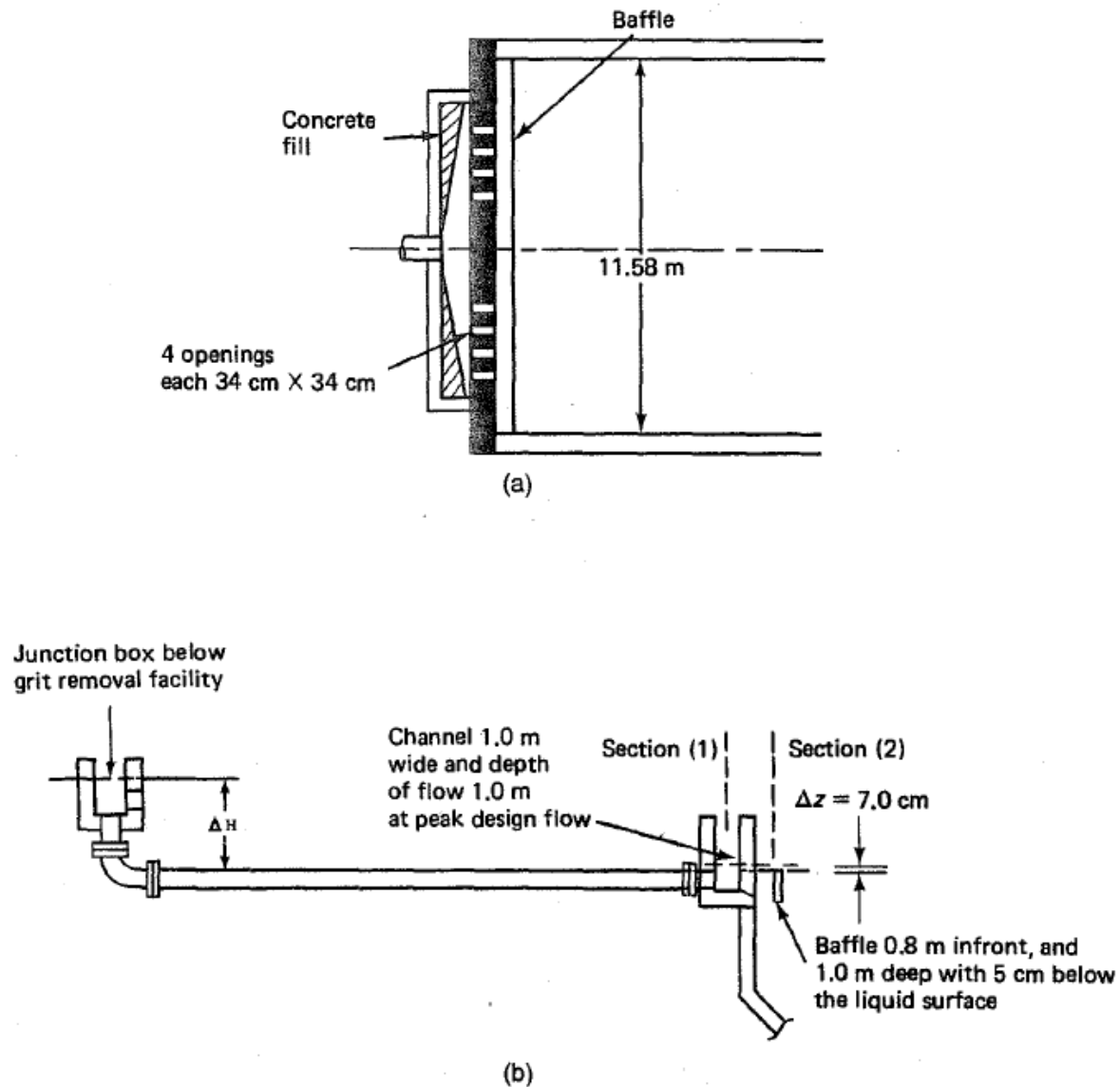


Figure 12-17 Example of Influent Structure and Piping Details: (a) plan of influent structure and (b) connecting pipes from junction box below the grit removal facility to the influent structure of the sedimentation basin.

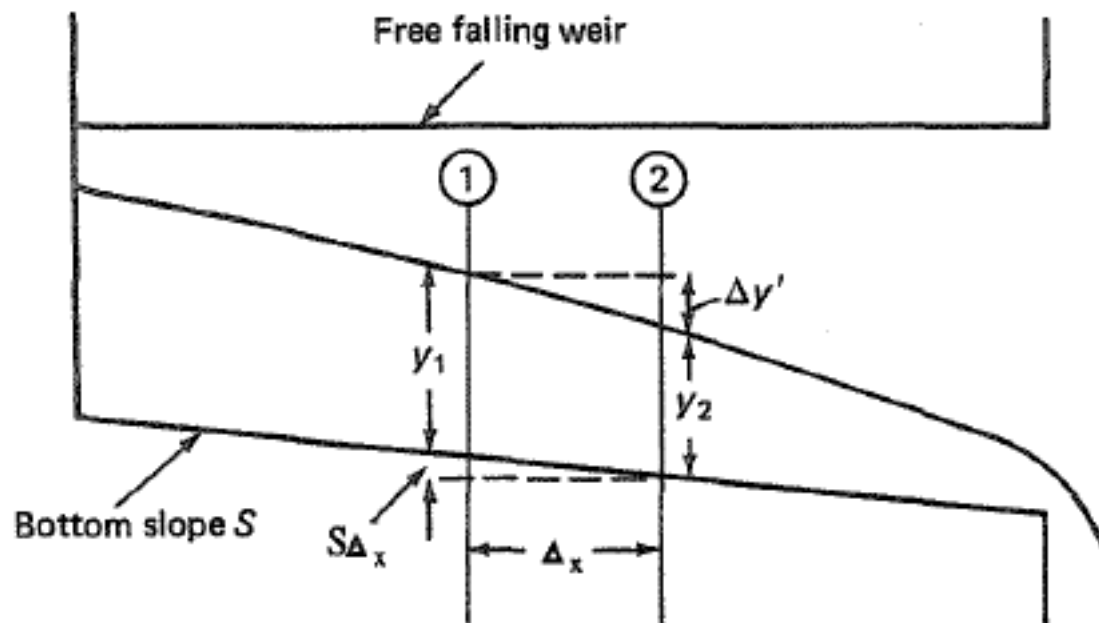


Figure 11-8 Water Surface Elevation in a Flume Receiving Weir Discharge.

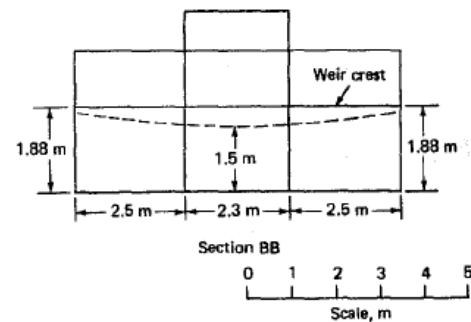
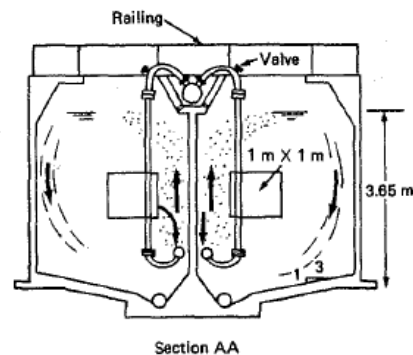
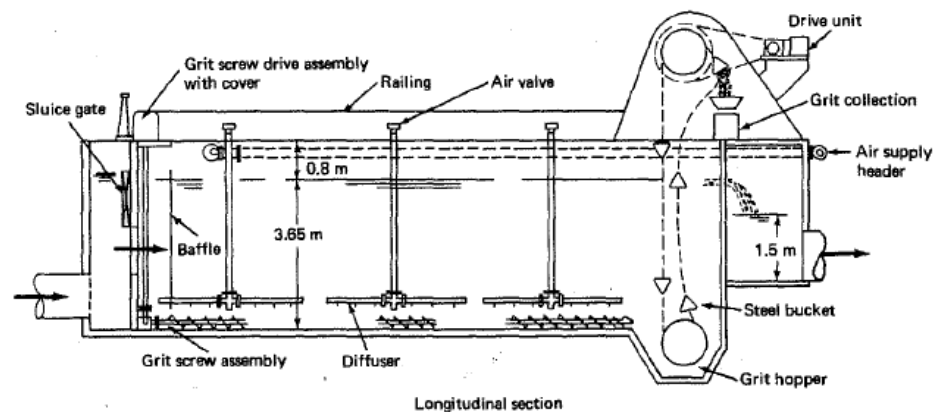
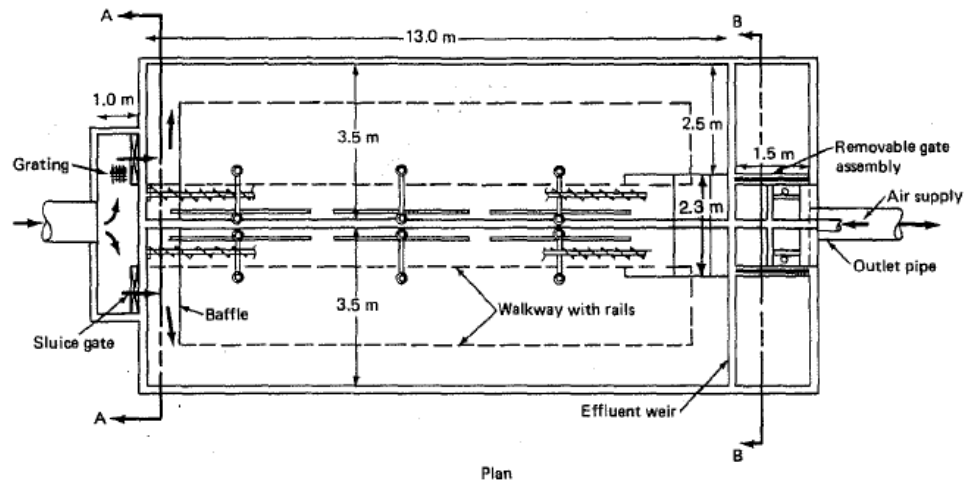


Figure 11-6 Design Details of Aerated Grit Chamber.

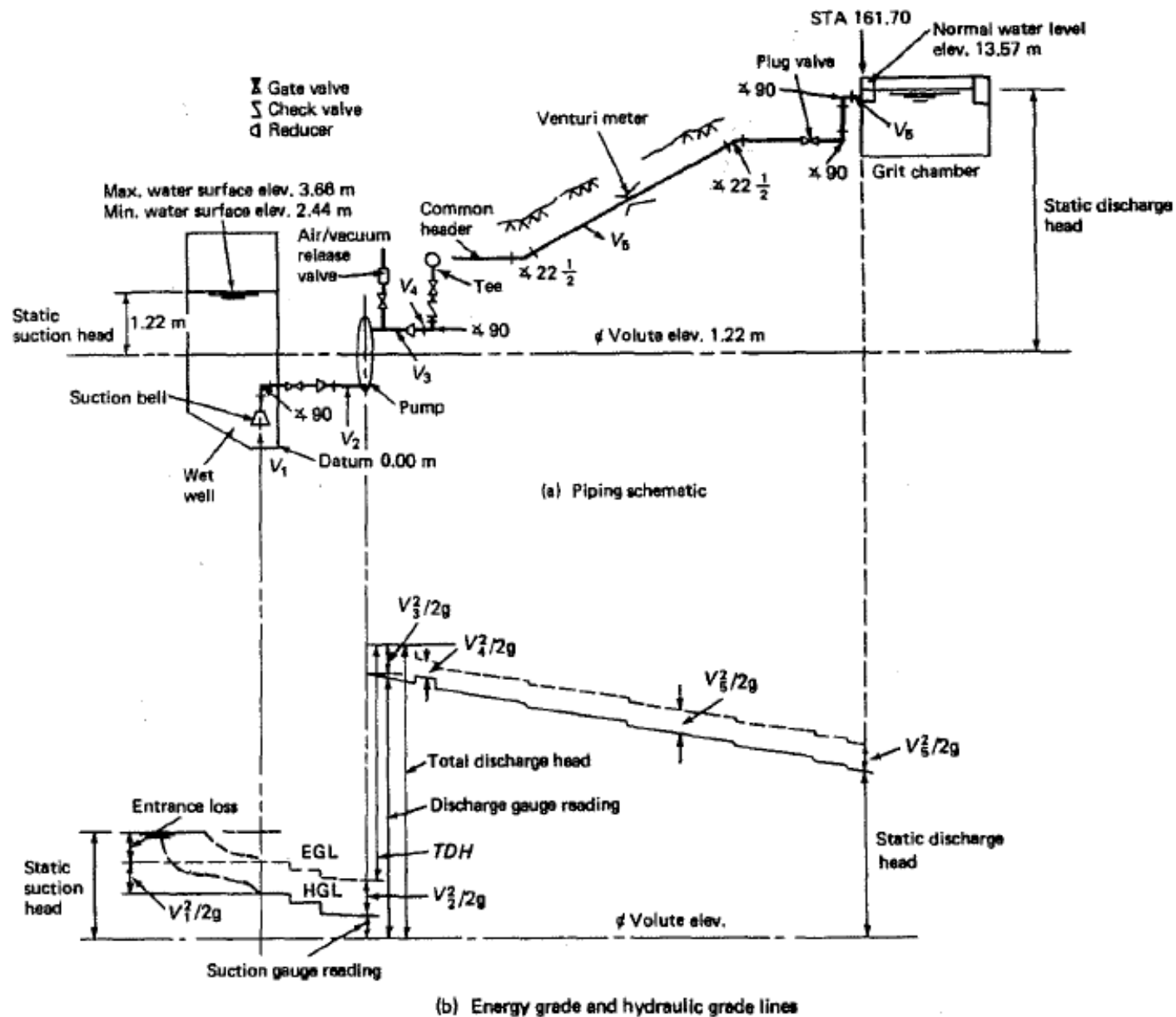


Figure 9-12 Piping Schematic Profile of Energy Grade and Hydraulic Grade Lines. All Elevations Are with Respect to Assumed Datum at the Floor Level of the Wet Well. See Figure 9-8 for STA Location.

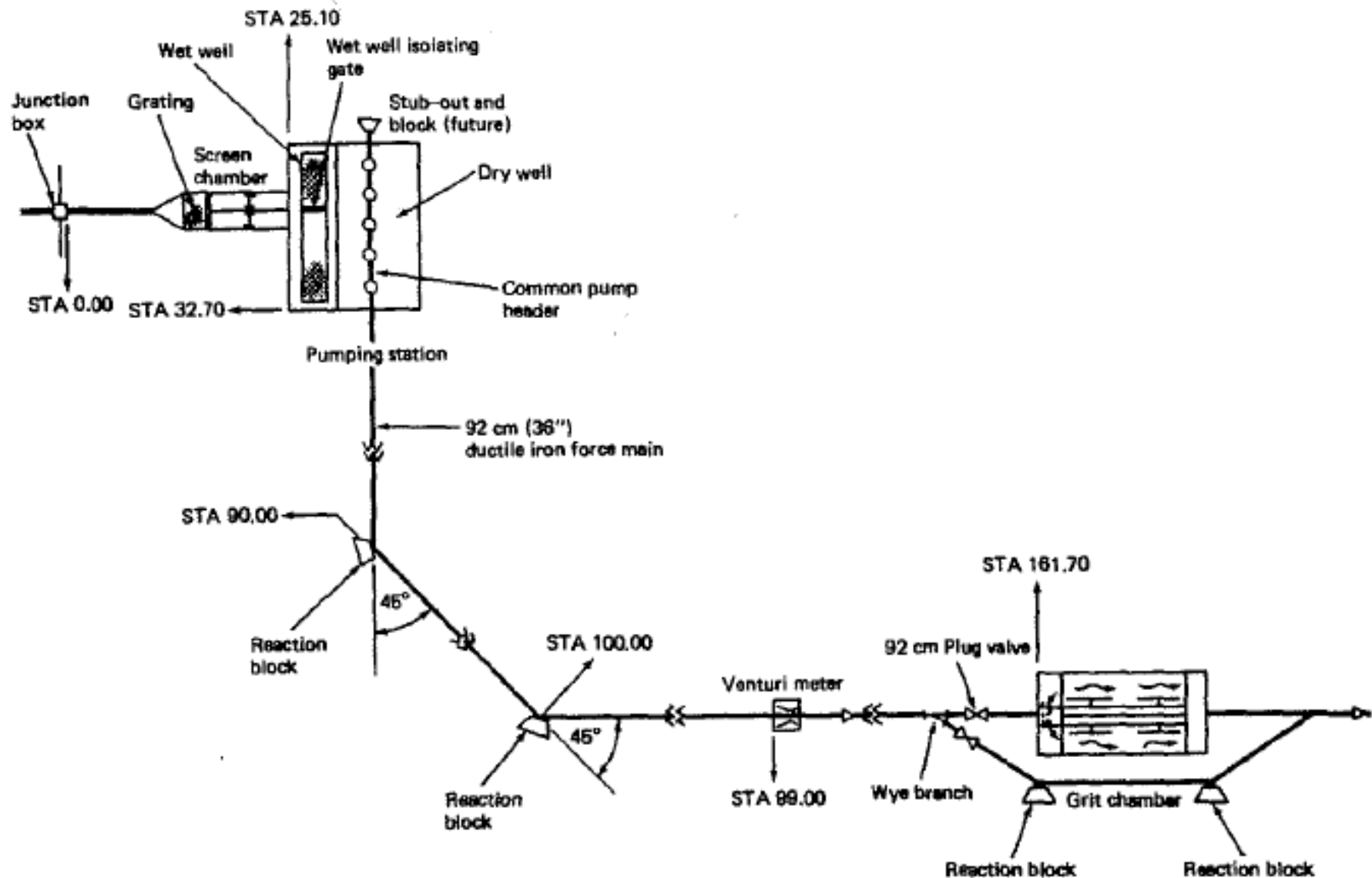
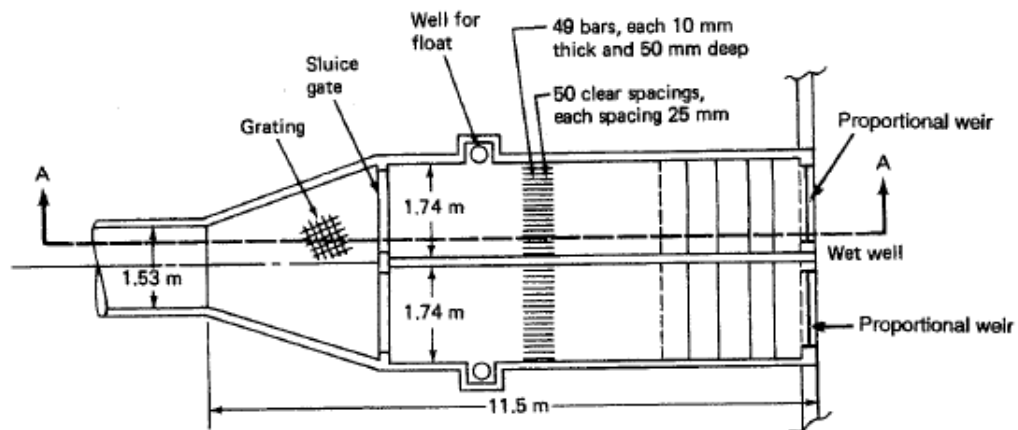
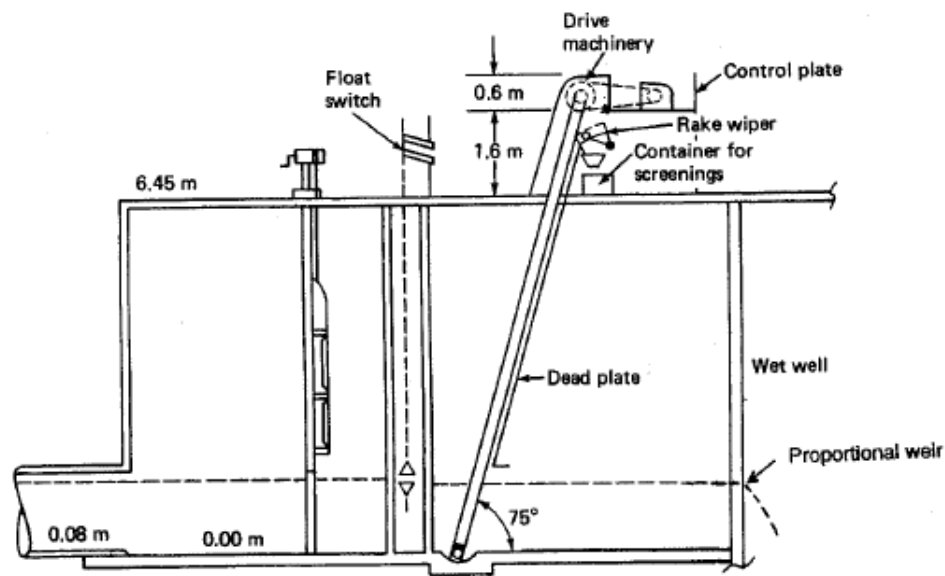


Figure 9-11 Piping Schematic and Layout of Bar Screen, Pumping Station, Flow Meter, and Grit Chamber. Reference Station STA 0.00 Is at the Junction Box. See Figure 20-4 for Details of Yard Pippings.



Plan



Section AA

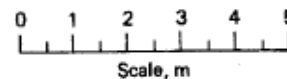


Figure 8-7 Design Details of Bar Rack. All Elevations Are with Respect to the Datum at the Floor of the Rack Chamber.

Flows and Head Losses

- Energy equation is used everywhere!
- Bar rack
 - Head losses
 - Expansion
 - Through bars
 - Critical flow at effluent structure free overfall
 - Proportional weir
- Pump station
 - System head curve – static lift, friction and minor losses
 - Pump performance

Flows and Head Losses

- Venturi flow meter
 - Venturi equation
- Grit chamber
 - Sized based on detention time and flow
 - Overflow rate based on area
 - Head losses in influent channel
 - Weir flow for effluent flow
 - Backwater analysis for flume with free overfall
 - Head loss caused by drag forces on baffle walls

Flows and Head Losses

- Primary Sedimentation
 - Sized for detention time and flow
 - Overflow rate
 - Head losses in influent structure, may include orifice flow through baffle wall
 - Weir flow at effluent structure
 - Open channel flow depth in launder
 - Head loss in pipe after launder
 - Junction box shows local total head

Flows and Head Losses

- Secondary Reactors
 - Sized for detention time and flow
 - Head losses in influent structure
 - Weir flow at effluent structure
 - Head loss in pipe to secondary clarifiers
- Secondary Clarifiers – like primary sedimentation
 - Head loss in pipe after launder
 - Junction box shows local total head

Flows and Head Losses

- Disinfection
 - Sized based on lamp operation
 - Head loss through lamps
 - Head loss through influent structure, typically rectangular weir
 - Parshall flume – see manufacturer's specifications for head loss and flow relationship
- Outfall
 - Open channel flow – Manning equation
 - Outfall pipe – friction and minor losses

Figure 21-1—cont'd

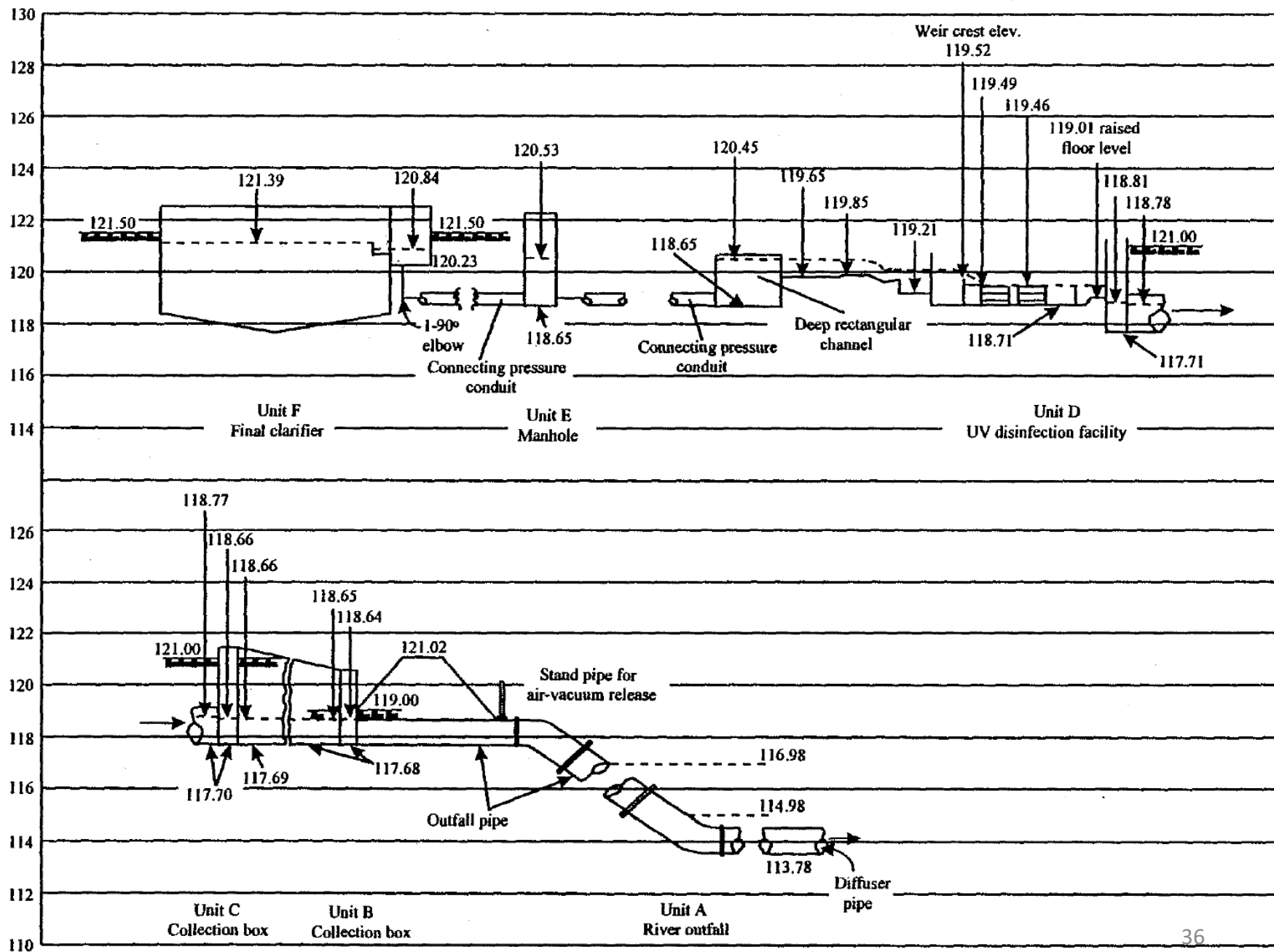


Figure 21-1 Hydraulic Profile through the Treatment Facility in the Design Example.

