UTM
UNIVERSITI TEKNOLOGI MALAYSIA

INSPIRING CREATIVE AND INNOVATIVE MINDS

www.utm.my

Specialized Short Course on
MEMBRANE TECHNOLOGY for Water and Wastewater Treatment

27 – 28 June 2009 (4 -5 Rajab 1430 H)

Prince Khalid bin Sultan Chair for Water Research
Civil Engineering Department, Hall 1 A 36
College of Engineering, King Saud University

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

INSPIRING CREATIVE AND INNOVATIVE MINDS

www.utm.my

Lecture 8

Design Procedures for RO & MBR: WASDA as Decision Support System

Prof. Dr. Ir. Zaini Ujang

Ph.D, P.Eng. (M), C.Eng. (UK), C.Sci. (UK), C.W.E.M. (UK), MIEM, DNS, PPI

Institute of Environmental and Water Resources Management (IPASA)

Universiti Teknologi Malaysia

Presentation Menu

- Decision Support System
- DSS Objectives
- WASDA & MBR in brief
- Procedures
- Results
- GROUP ASSIGNMENT

Decision Support System

- Interactive computer-based tools used by decision makers since 1960s to help answer questions, solve problems and support or refute conclusions
- Concepts: Spreadsheets, databases, networks, hypermedia, expert systems, visual programming, intelligent agents, neural networks, etc.
- Potential to improve decision quality, competitive edge, time-saving and productivity when users have both sufficient technical knowledge of the system and enough experience of the job.
- Widely used for the solution of various engineering and management problems

Learning Outcomes and Objectives

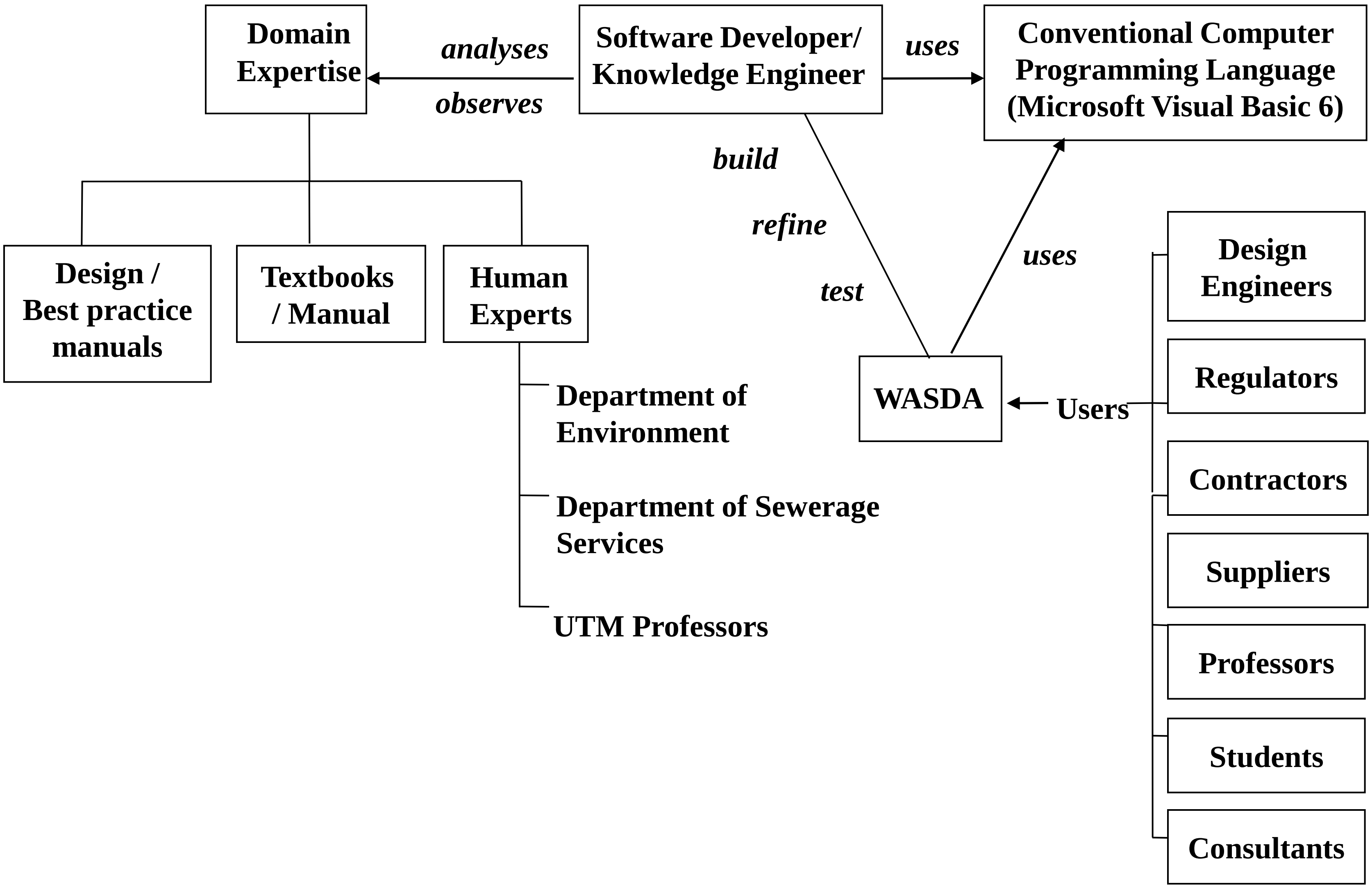
- WASDA as a decision support system for designing membrane processes
- Practice designing Reverse Osmosis (RO) and Membrane Bioreactor (MBR) systems.
- To perform tasks as consultants, design engineers and policy makers in relation to membrane processes

WASDA in Brief

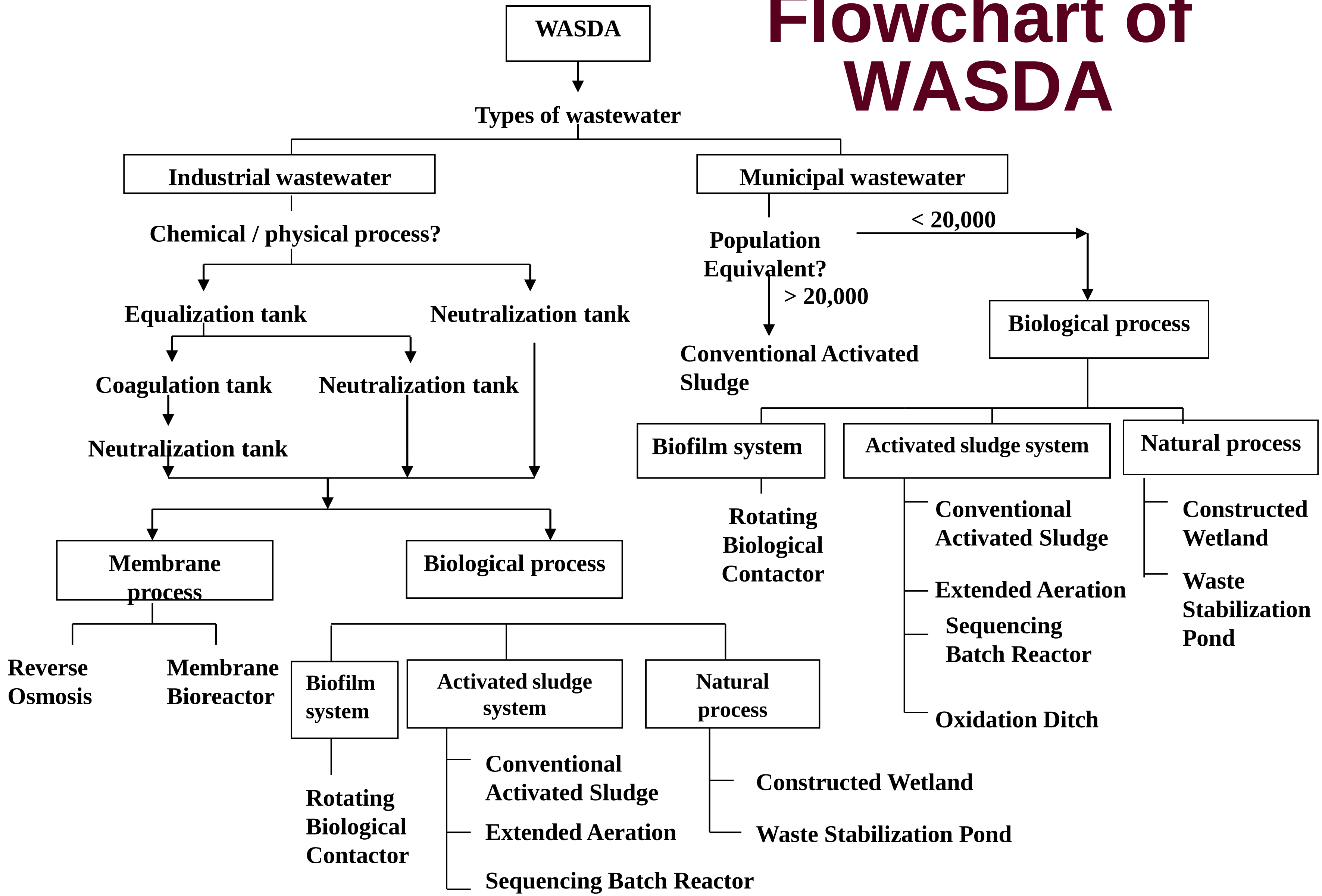
- Wastewater Treatment Plant Design Advisor.
- DSS was developed by IPASA-UTM, esp. for wastewater treatment plant design and decision making
- Contains 2 main parts:
- (a) Knowledge / information base
- (b) Design calculation spreadsheet

- Provides conceptual & process design recommendations for conventional wastewater, primary, secondary & advanced treatments – proposed by best practical manuals / public authorities (sewerage services / environmental control).
- Mainly focused on municipal and industrial applications to produce conceptual and process design for primary, secondary and advanced treatments.

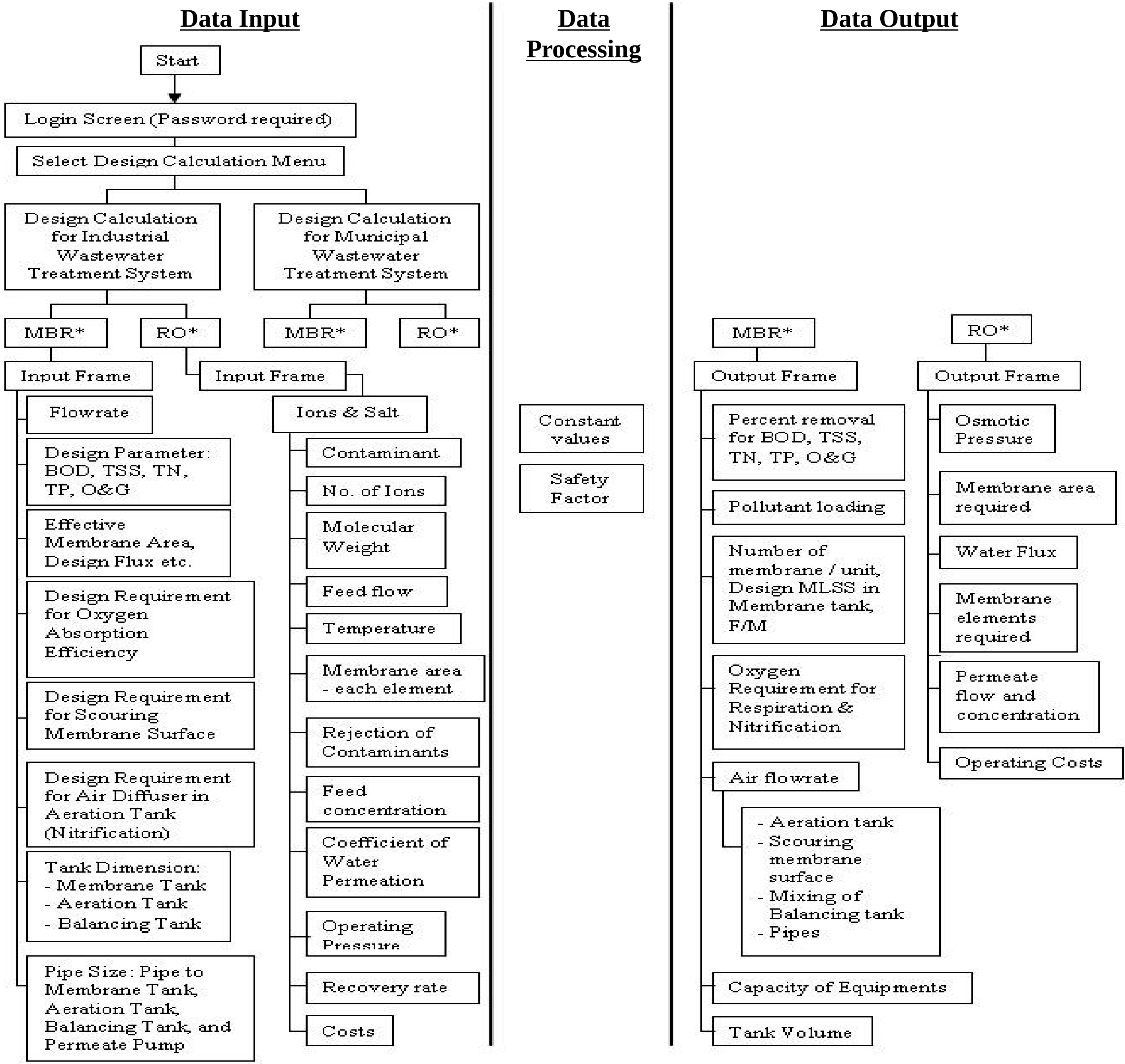
WASDA Development Process



Flowchart of WASDA

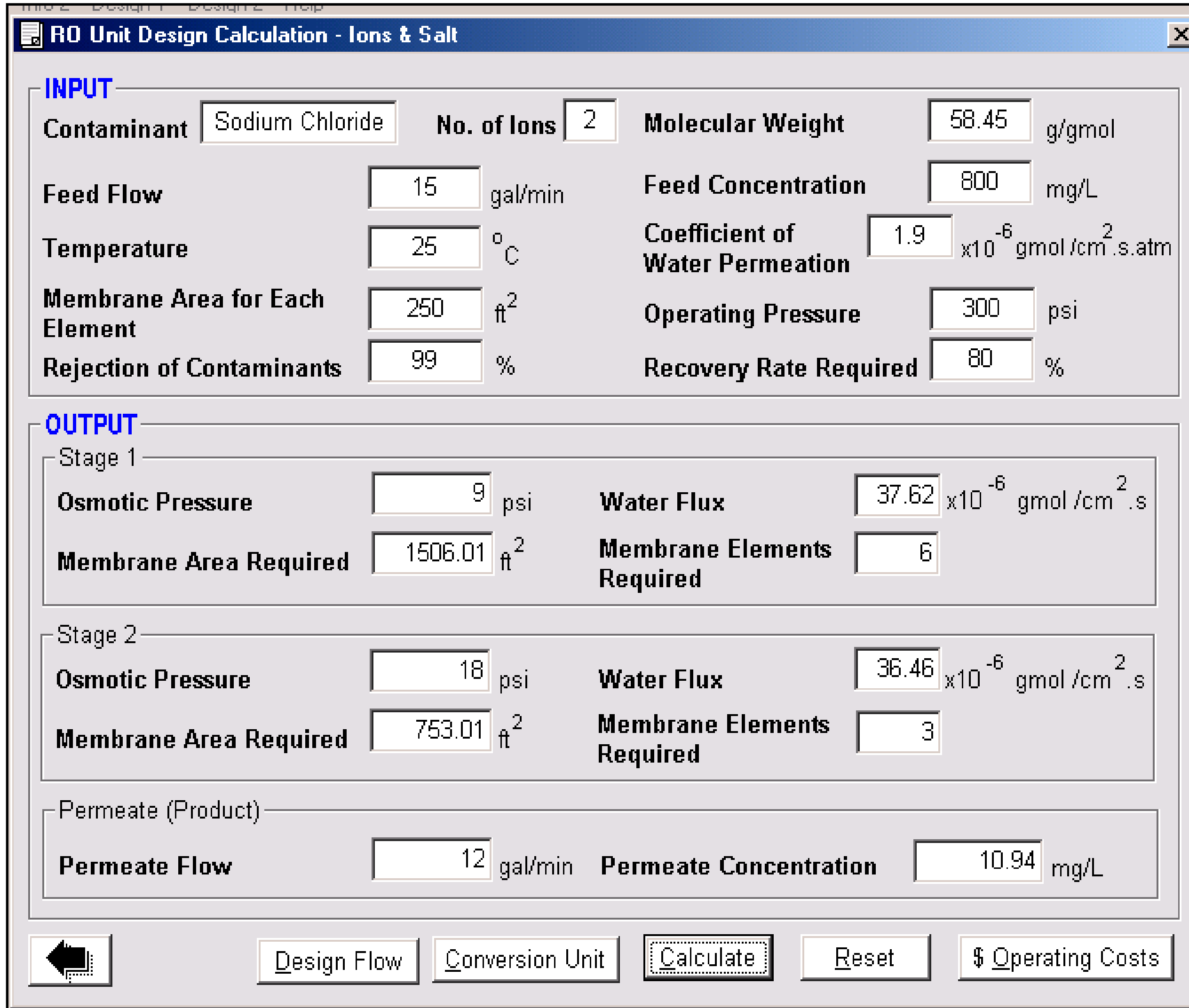


Achitecture of MBR & RO Modules



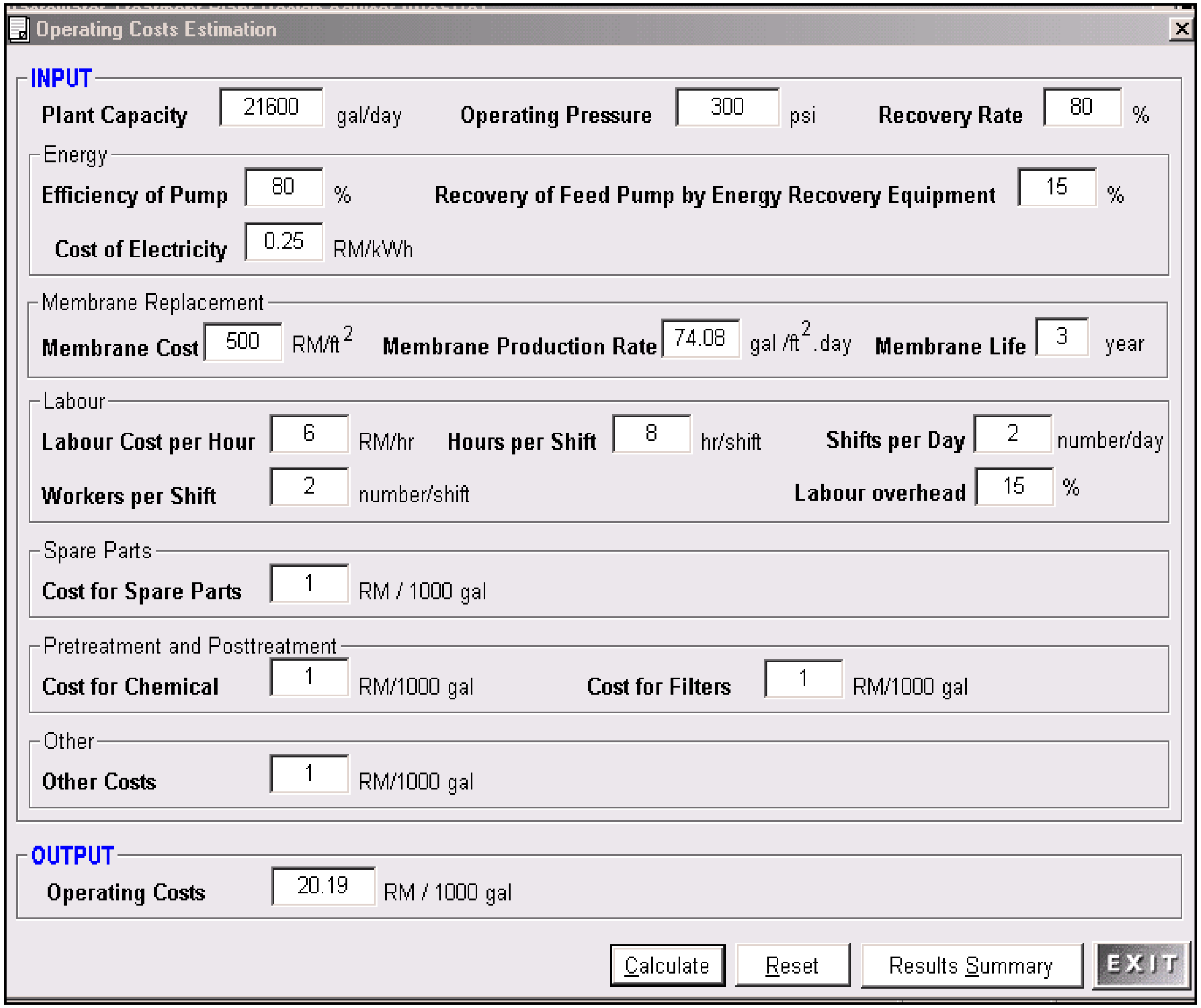
Design Procedures

Calculation Screen for RO Module: Ions & Salt Removal



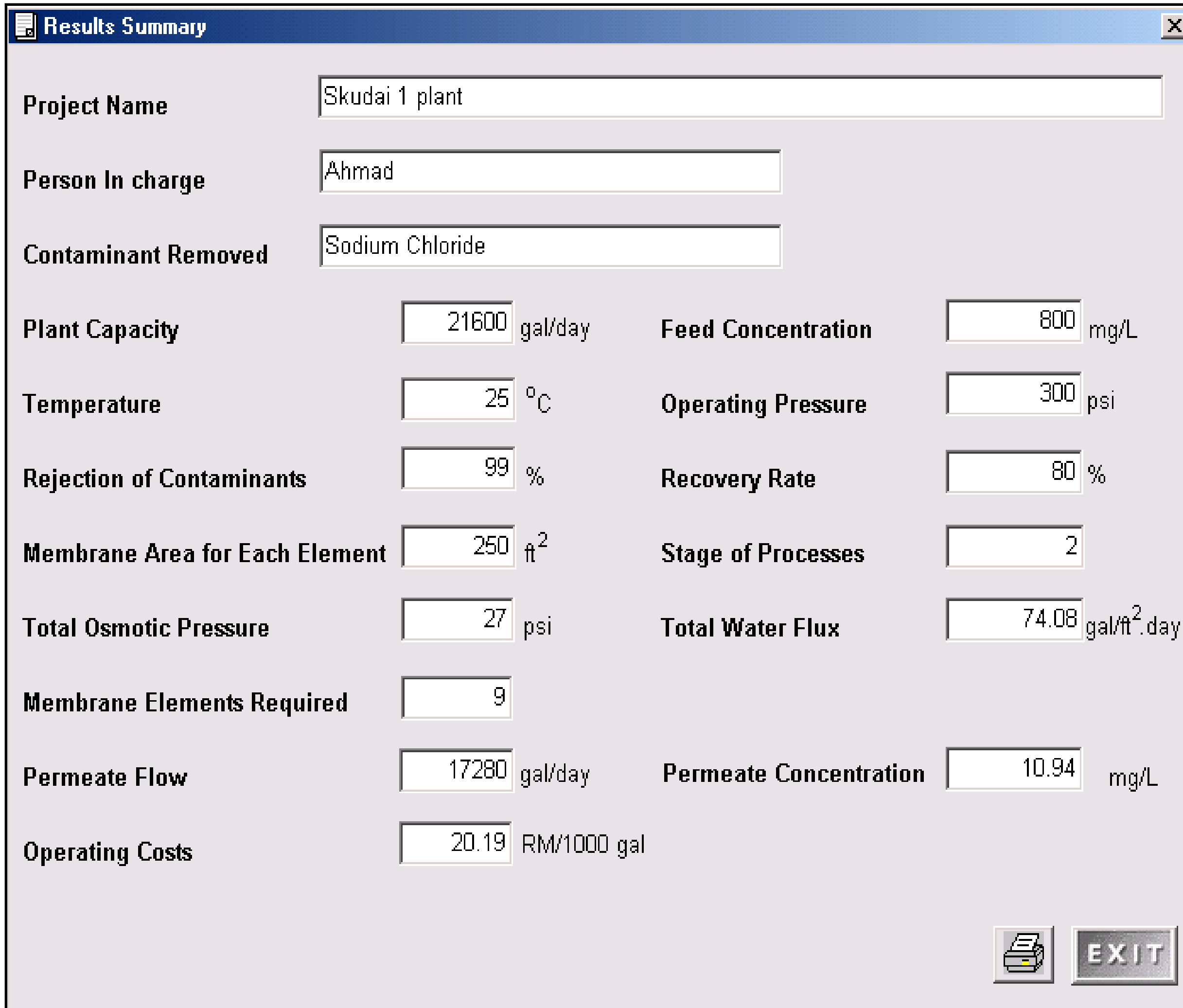
Design Procedures

Cost Estimation Screen for RO Module: Ions & Salt Removal



Design Procedures

Result Summary Screen for RO Module: Ions & Salt Removal



Results Summary

Project Name	Skudai 1 plant
Person In charge	Ahmad
Contaminant Removed	Sodium Chloride

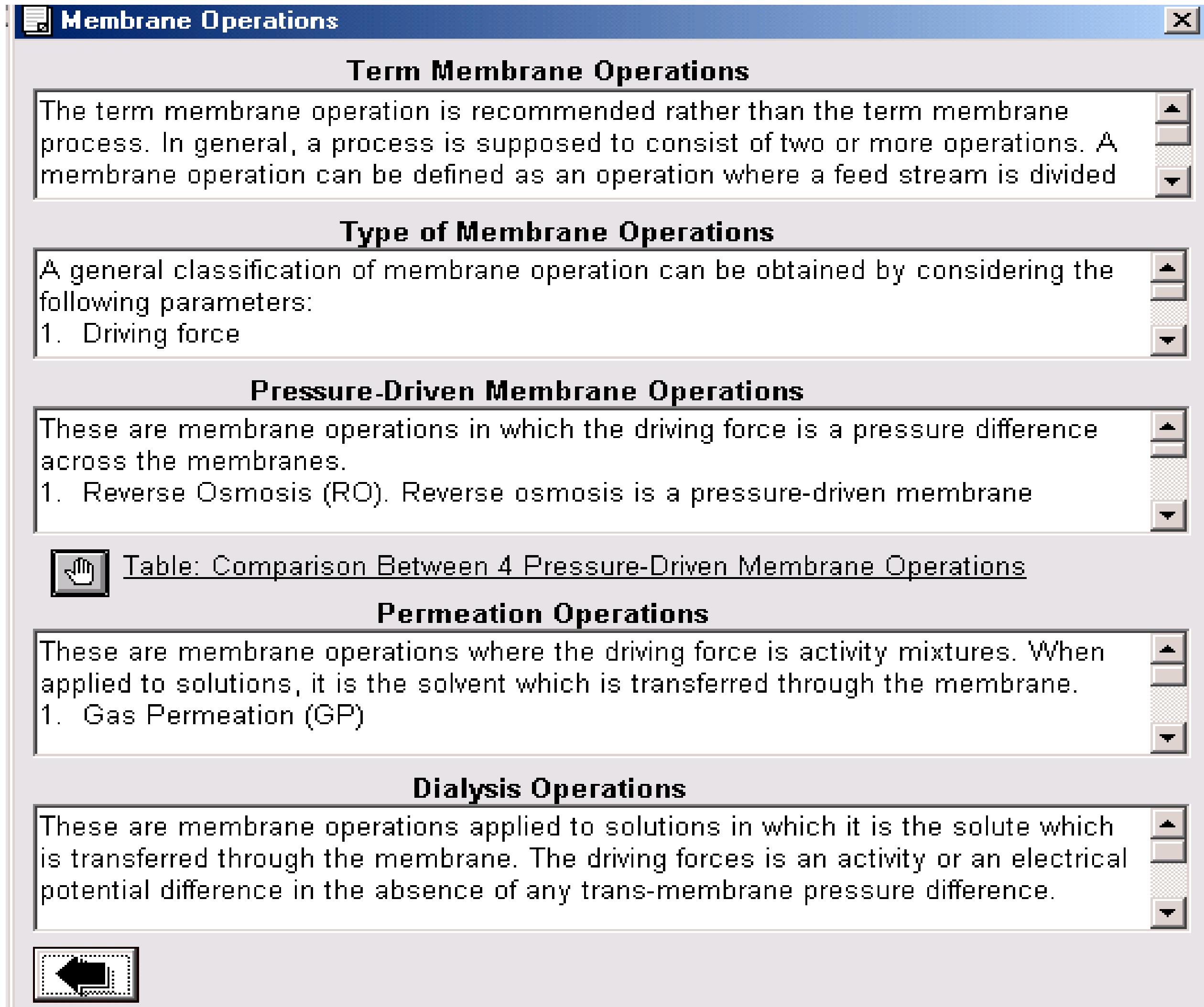
Plant Capacity	21600	gal/day	Feed Concentration	800	mg/L
Temperature	25	°C	Operating Pressure	300	psi
Rejection of Contaminants	99	%	Recovery Rate	80	%
Membrane Area for Each Element	250	ft^2	Stage of Processes	2	
Total Osmotic Pressure	27	psi	Total Water Flux	74.08	$gal/ft^2.day$
Membrane Elements Required	9				
Permeate Flow	17280	gal/day	Permeate Concentration	10.94	mg/L
Operating Costs	20.19	RM/1000 gal			

EXIT

Other Info in WASDA

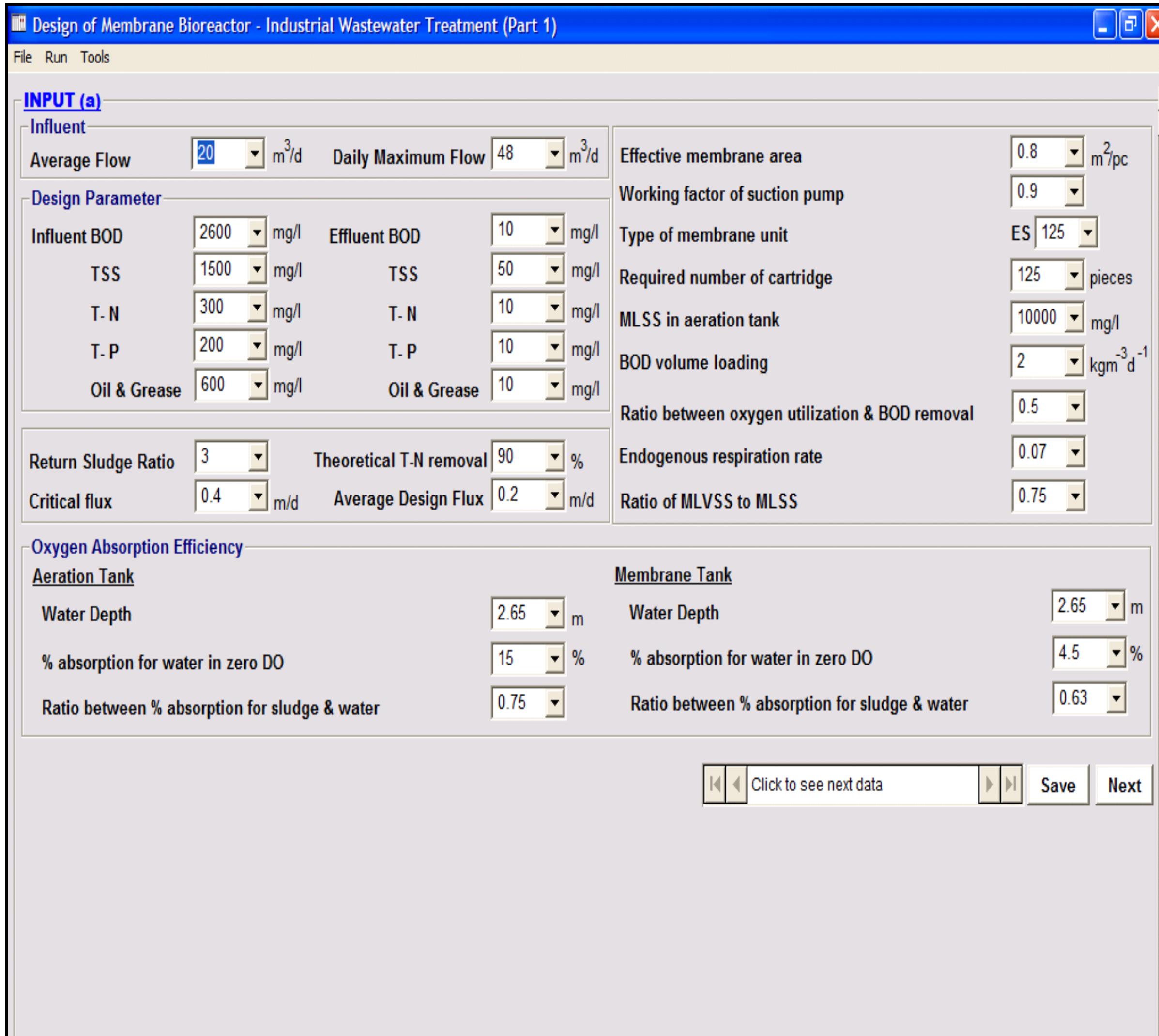
Other info
In WASDA

Information Screen for RO module



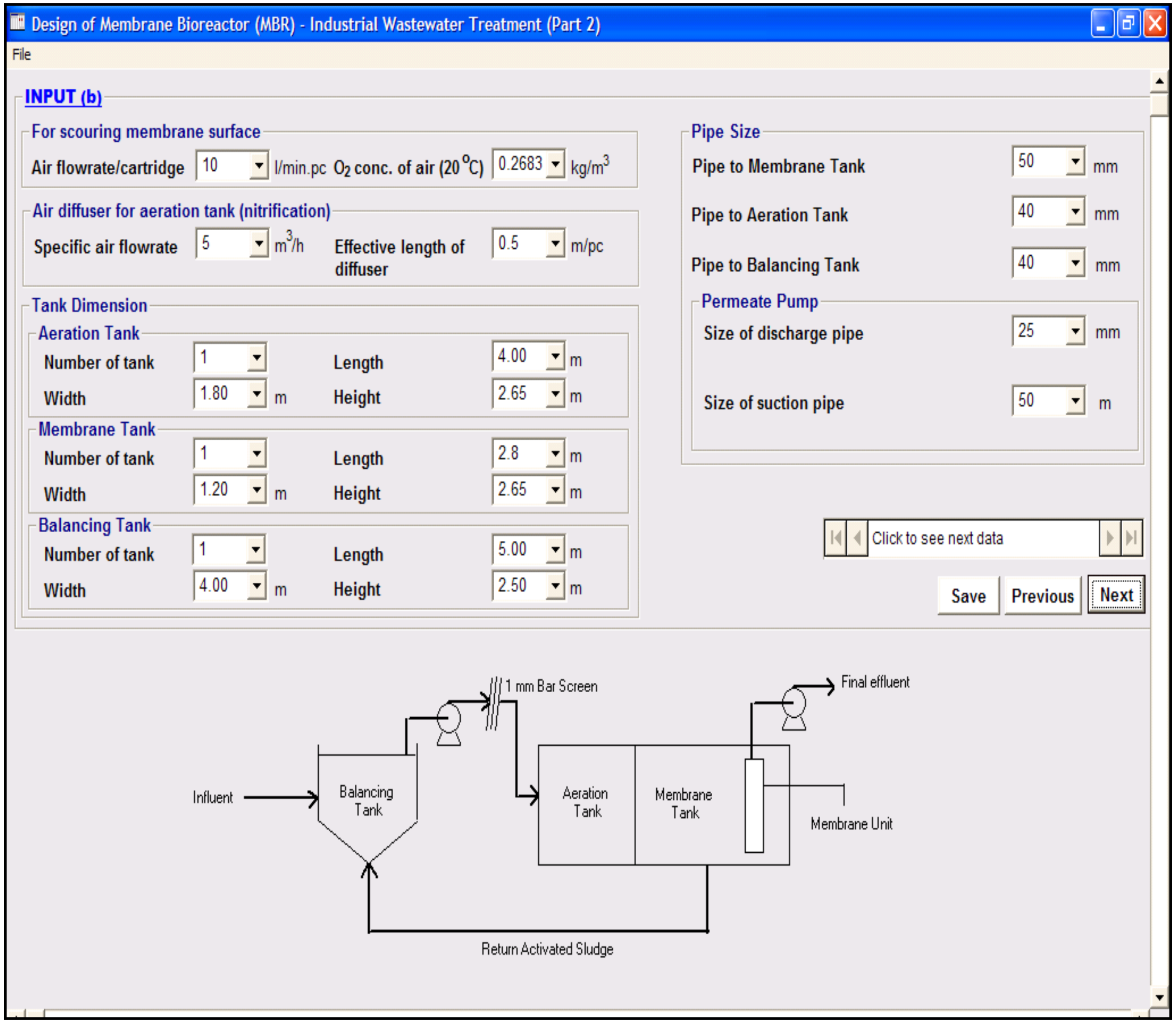
Design Results

Input Screen for MBR module – Part 1



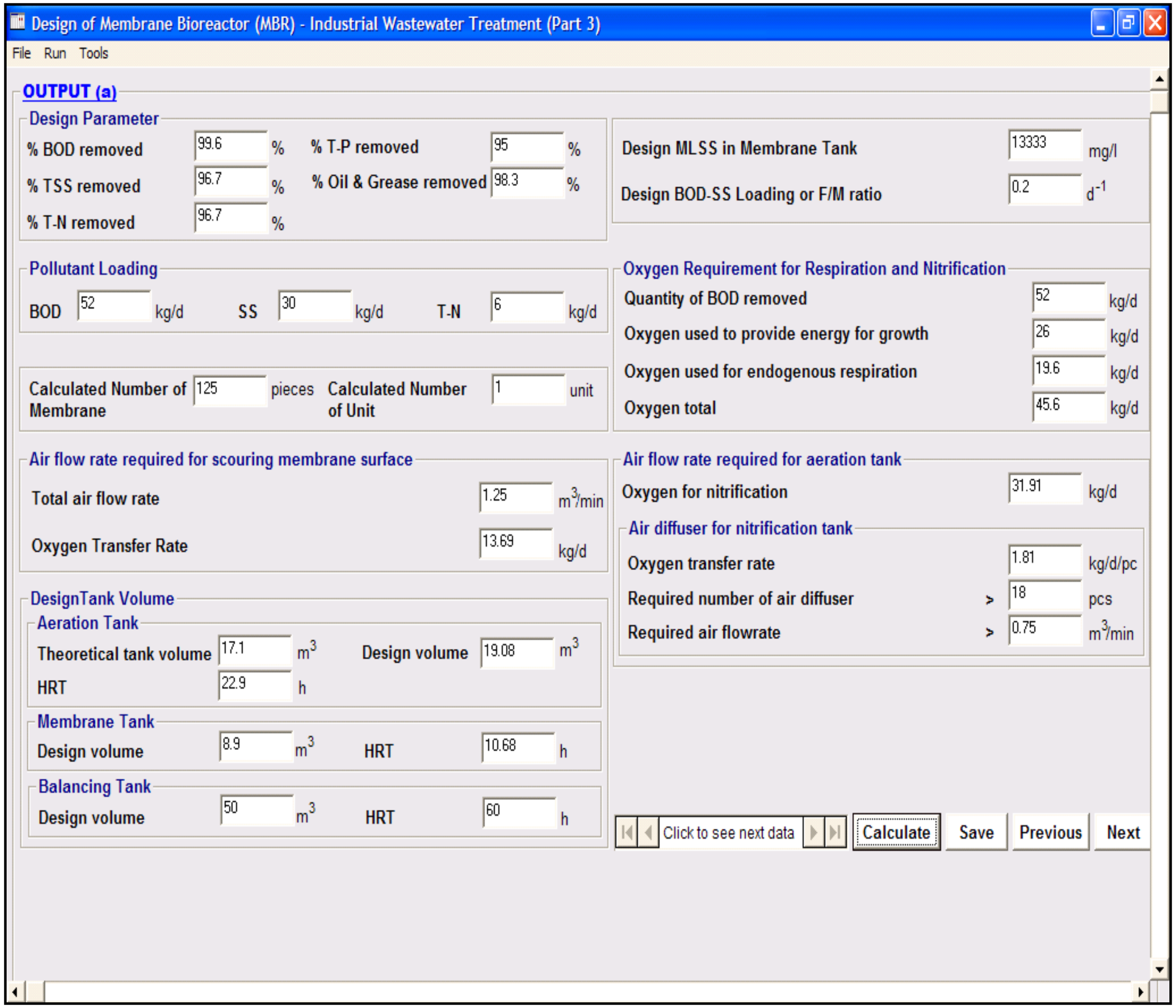
Design Results

Input Screen for MBR module – Part 2



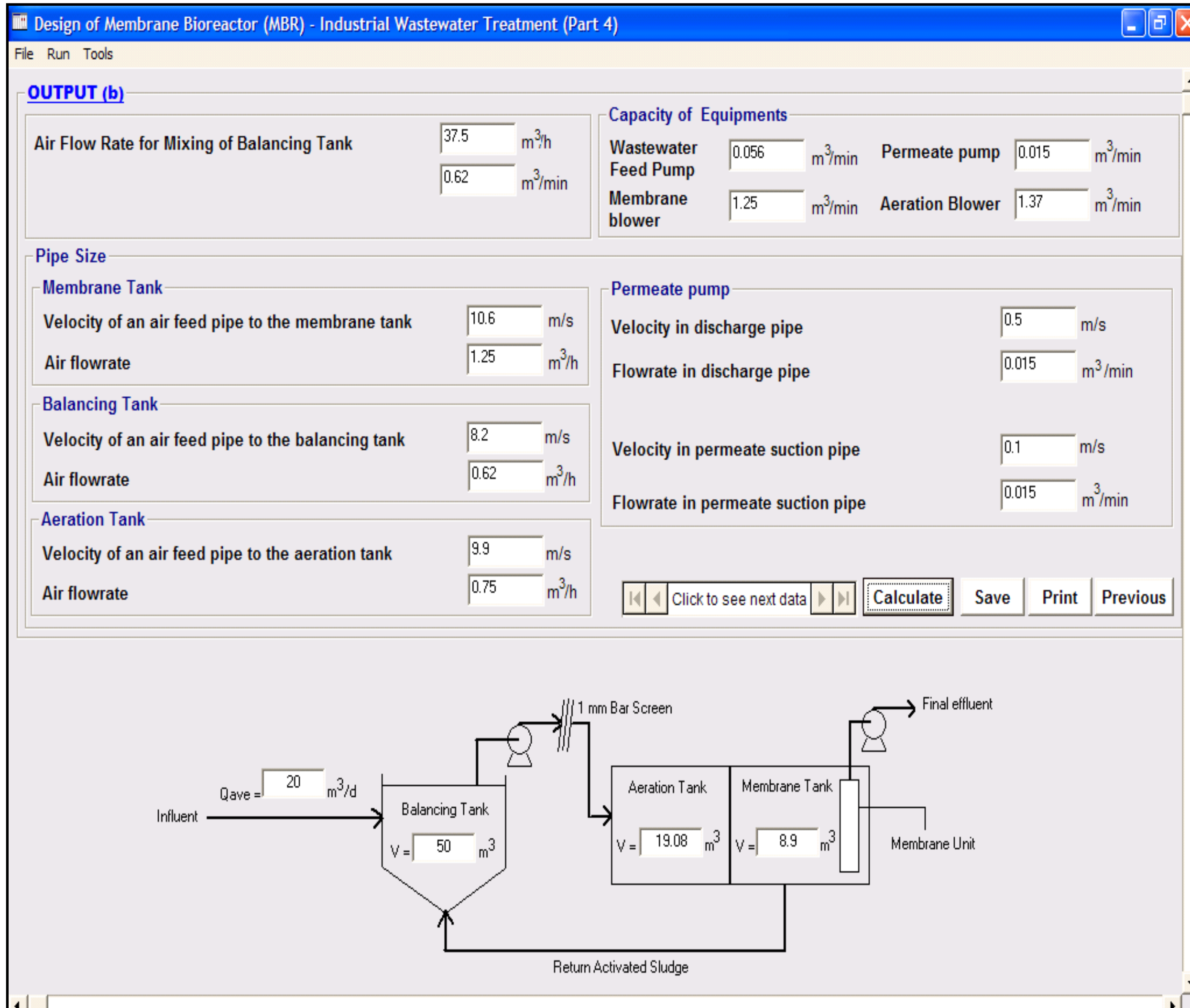
Design Results

Output Screen for MBR module – Part 1

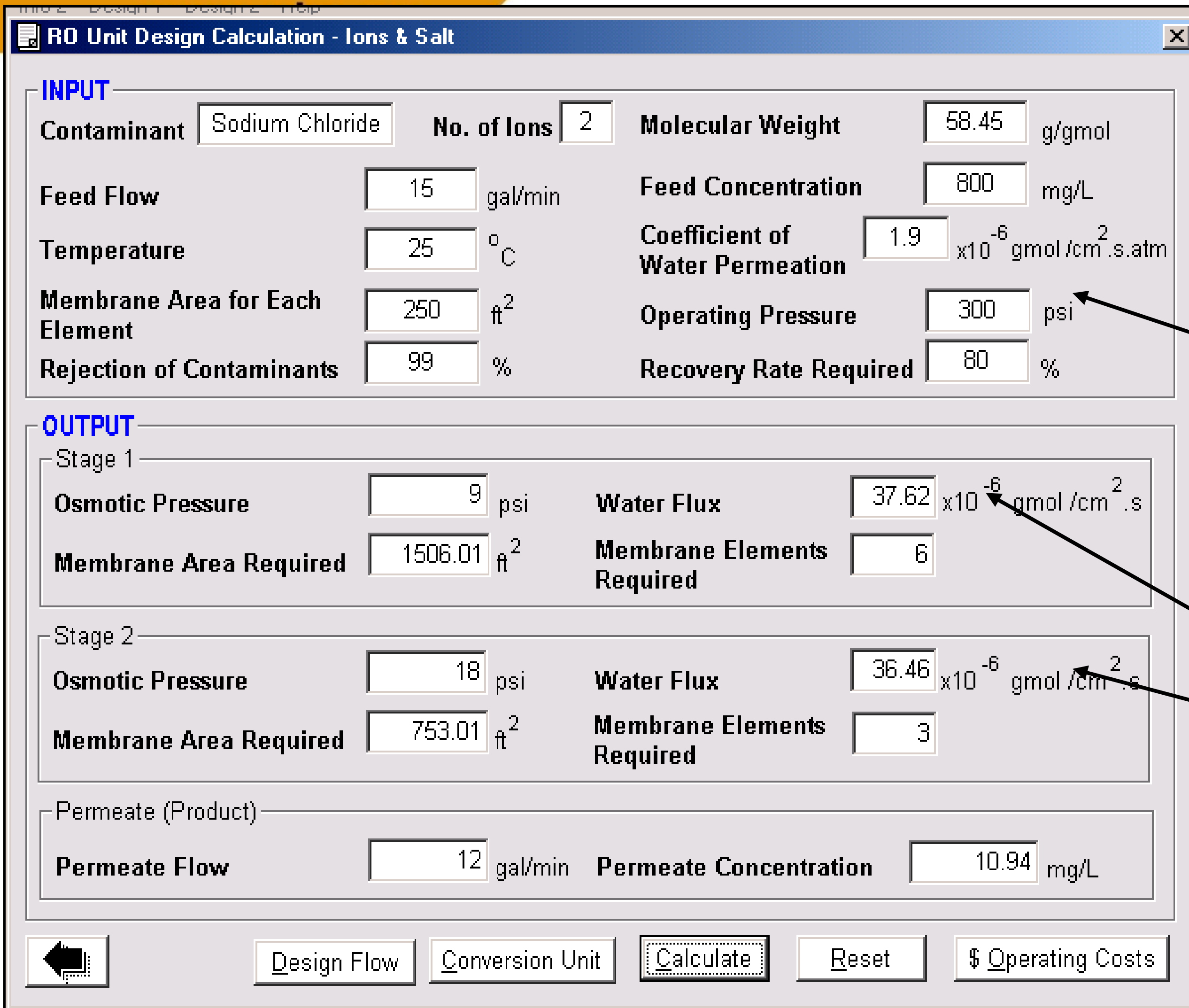


Design Results

Output Screen for MBR module – Part 2



Validation



Change *Operating Pressure* to evaluate change in *Water Flux*

Reactor Volume

Validation of Output: Descriptive Statistic Analysis

	Manual Calculation	WASDA
Mean	0.337785	0.337788
Standard Error	0.024246	0.024246
Median	0.341284	0.341287
Standard Deviation	0.059390	0.059390
Sample Variance	0.003527	0.003527
Kurtosis	**-1.126304**	**-1.126312**
Skewness	-0.213180	-0.213190
Range	0.158761	0.158762
Minimum	0.254017	0.254019
Maximum	0.412778	0.412781
Sum	2.026710	2.026726
Count	6.000000	6.000000

Group Design Assignment

Problem statement:

Water resources for Seremban, Nilai and Port Dickson to are to be upgraded in terms of resource availability and water quality. The existing dams (3) are no longer sufficient to provide enough volume for 2010. There are 2 options to meet this requirements, and for upgrading for 2015:

1. A new dam which cost RM1.2 billion located in a reserved forest in Jelebu district, or
2. An advanced water treatment plant, located downstream of Sungai Linggi.

Task:

As a consulting group, you are assigned to evaluate the feasibility of using membrane systems. Your opinion will be evaluated in a group presentation session, based both on technical and financial aspects.