

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.C. 20314

Engineer Manual
No. 1110-2-504

30 November 1983

Engineering and Design
LAND TREATMENT SYSTEMS
OPERATION AND MAINTENANCE

Table of Contents

	Subject	Paragraph	Page
CHAPTER 1.	INTRODUCTION		
	General-----	1-1	1-1
	Purpose and Scope-----	1-2	1-1
	Definitions-----	1-3	1-2
CHAPTER 2.	SLOW RATE SYSTEMS		
Section I.	Process Description		
	Introduction-----	2-1	2-1
	Hydraulic Loading-----	2-2	2-3
	System Types and Management-----	2-3	2-4
Section II.	Staffing Requirements		
	Introduction-----	2-4	2-5
	General Skills-----	2-5	2-6
	Special Skills-----	2-6	2-6
Section III.	Process Control and Monitoring		
	Introduction-----	2-7	2-6
	Compliance Monitoring-----	2-8	2-7
	Process Control Monitoring-----	2-9	2-13
	Laboratory Equipment and Procedures-----	2-10	2-21
Section IV.	Routine Operating Procedures		
	Preapplication Treatment Components-----	2-11	2-21
	Storage Ponds-----	2-12	2-21
	Application Rates and Schedules-----	2-13	2-21
	Operation at Agricultural Sites-----	2-14	2-25
	Crop Management at Agricultural Sites-----	2-15	2-25
	Operation at Forested Sites-----	2-16	2-29
	Recreational Sites-----	2-17	2-29
Section V.	Emergency Procedures		
	Disruption of Schedule-----	2-18	2-30
	Odors-----	2-19	2-31
Section VI.	Maintenance Considerations		
	Ponds-----	2-20	2-31
	Mechanical Equipment-----	2-21	2-31

	Subject	Paragraph	Page
CHAPTER 3.	OVERLAND FLOW SYSTEMS		
	Process Description-----	3-1	3-1
	Staffing Requirements-----	3-2	3-2
	Initial Startup-----	3-3	3-2
	Process Control and Monitoring-----	3-4	3-2
	Routine Operating Procedures-----	3-5	3-3
	Emergency Procedures-----	3-6	3-5
	Maintenance Considerations-----	3-7	3-6
CHAPTER 4.	RAPID INFILTRATION SYSTEMS		
	Process Description-----	4-1	4-1
	Staffing Requirements-----	4-2	4-1
	Process Control and Monitoring-----	4-3	4-1
	Routine Operating Procedures-----	4-4	4-2
	Emergency Procedures-----	4-5	4-3
	Maintenance Considerations-----	4-6	4-3
APPENDIX A.	SAMPLE CALCULATIONS		A-1
APPENDIX B.	Bibliography		B-1

LIST OF FIGURES

Figure 2-1.	Slow rate hydraulic pathways-----	2-1
2-2.	Personnel needs for land treatment portion of slow rate systems-----	2-5
2-3.	Typical shallow monitoring well-----	2-11
2-4.	Water level determination in observation well-----	2-12
2-5.	Typical monitoring layout-----	2-13
2-6.	Special spray nozzle for winter operations-----	2-30
A-1.	Major components of a land treatment system-----	A-1

LIST OF TABLES

Table 2-1.	Typical characteristics of slow rate land treatment systems-----	2-2
2-2.	Slow rate system types and management needs-----	2-4
2-3.	Guidance for assessing level of preapplica- tion treatment-----	2-8
2-4.	State control of monitoring-----	2-9

Subject	Paragraph	Page
2-5. Number of states with monitoring criteria-----		2-9
2-6. Typical monitoring schedule for applied wastewater-----		2-10
2-7. Monitoring of storage pond effluents----		2-16
2-8. Soil monitoring on agricultural sites----		2-18
2-9. Vegetation monitoring on agricultural sites-----		2-19
2-10. Vegetation sampling - field pattern and plant part-----		2-20
2-11. Field estimating of soil moisture content-----		2-28
2-12. Troubleshooting guide-----		2-32
3-1. Average runoff water quality-----		3-1