



Natural Resources Conservation Service
101 SW Main Street; Suite 1300
Portland, Oregon
Phone: (503) 414-3247 Fax: (503) 414-3277

IRRIGATION SYSTEM DESIGN

Introduction

- The material provided in this section is intended to serve as a framework for irrigation system design training.
- Trainers should modify the training material referenced as necessary to achieve the planned skill level for the trainees.
- Trainers are encouraged to include locally developed training materials to complement and/or supplement the referenced material.
- As new training materials are developed by trainers, they are encouraged to furnish copies to the National Employee Development Center for inclusion in future versions of the assembled material.

Suggested Objectives

1. Determine which type of irrigation system is appropriate for given specific site conditions, i.e. soil properties and crop data.
2. Specify materials and components to make a complete system that optimizes the balance between capital investment and operation and maintenance costs.
3. Prepare a performance table for the system listing total application versus time based on the average application rate.
4. Develop complete drawings and specifications for system layout, and operation.

Suggested Outline

- I. Introduction
- II. Body
 - A. Irrigation System Selection Based on Specific Site Conditions
 1. Types of systems
 2. Advantages/disadvantages
 3. Theory of selected system
 4. Specific site requirements
 - B. Materials and Components for a Cost-Effective System



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IRRIGATION SYSTEM DESIGN

1. Specific construction requirements
 2. Materials vs. cost
 - C. Performance Table
 - D. Drawings and Specifications
- III. Summary

System Design

1. Fixed (Solid Set) Sprinkler Irrigation Design.
2. Periodic Move Sprinkler Irrigation Design.
3. Center Pivot Sprinkler Irrigation Design.
4. Traveling Gun Sprinkler Irrigation Design.
5. Lateral Move (Linear Move) Sprinkler Irrigation Design.
6. Level Border Irrigation Design.
7. Graded Border Irrigation Design.
8. Level Furrow Irrigation Design.
9. Graded Furrow Irrigation Design.
10. Subsurface Irrigation System Design.
11. Contour Ditch Irrigation System Design.
12. Trickle Irrigation System Design.
13. Pumping Plant Design.
14. Chemigation/Fertigation Design.
15. Filtration Design.
16. "Low Energy Precision Application (LEPA)/Low Pressure In Application (Lpic)". Canopy
17. Level Basin/Levee Design.
18. Well Design.
19. Tailwater Recovery.

Material covered in this section

- Reference Material,
- Toolbox Material,
- Facilitation Options, and
- Evaluation.



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IRRIGATION SYSTEM DESIGN

1. Fixed (Solid Set) Sprinkler Irrigation Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG, Section IV.

• **Toolbox Material**

- .
- Publication "Irrigation Hydraulics", Instructors Manual, Hunter Industries.
- Publication "Irrigation Hydraulics", Student Manual, Hunter Industries.
- Publication "Precipitation Rates and Sprinkler Irrigation", Instructor's Manual, Hunter Industries.
- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000
- Publication "Sprinkler Irrigation Systems", Midwest Planning Service, MWPS –30, 1999 (Located in the Irrigation System Planning Toolbox)



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IRRIGATION SYSTEM DESIGN

2. Periodic Move Sprinkler Irrigation Design

Reference Material

- Irrigation Guide 6.
- NEH 15.
- FOTG Section IV.

Toolbox Material

- Publication "Irrigation Hydraulics", Instructors Manual, Hunter Industries.
- Publication "Irrigation Hydraulics", Student Manual, Hunter Industries.
- Publication "Precipitation Rates and Sprinkler Irrigation", Instructor's Manual, Hunter Industries.
- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000
- Publication "Sprinkler Irrigation Systems", Midwest Planning Service, MWPS –30, 1999 (Located in the Irrigation System Planning Toolbox)



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3. Center Pivot Sprinkler Irrigation System

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG, Section IV.

Toolbox Materials

- Lesson Plan "Selecting Sprinkler Packages for Center Pivot Systems", University of Nebraska
- Publication "Sprinkler Design Problem", NRCS, Kansas.
- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000
- Publication "Sprinkler Irrigation Systems", Midwest Planning Service, MWPS -30, 1999 (Located in the Irrigation System Planning Toolbox)
- DVD "Assuring Efficient Center Pivot Irrigation"



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4. Traveling Gun Sprinkler Irrigation Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG Section IV.

Toolbox Material

- Publication "Irrigation Hydraulics", Instructors Manual, Hunter Industries.
- Publication "Irrigation Hydraulics", Student Manual, Hunter Industries.
- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000
- Publication "Sprinkler Irrigation Systems", Midwest Planning Service, MWPS –30, 1999 (Located in the Irrigation System Planning Toolbox)

5. Lateral Move (Linear Move) Sprinkler Irrigation Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG Section IV.

Toolbox Material

- Publication "Irrigation Hydraulics", Instructors Manual, Hunter Industries.
- Publication "Irrigation Hydraulics", Student Manual, Hunter Industries.
- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000
- Publication "Sprinkler Irrigation Systems", Midwest Planning Service, MWPS –30, 1999 (Located in the Irrigation System Planning Toolbox)



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6. Level Border Irrigation Design

Reference Material:

- NEH 15.
- FOTG Section IV.

Toolbox Material

- Publication "The Surface Irrigation Manual", ITRC, Cal-Poly.

7. Graded Border Irrigation Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG Section IV.

Toolbox Material

- Publication "The Surface Irrigation Manual", ITRC, Cal-Poly.



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8. Level Furrow Irrigation Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG Section IV.

Toolbox Material

- Publication "The Surface Irrigation Manual", ITRC, Cal-Poly.

9. Graded Furrow Irrigation Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15, Chapter 5.
- FOTG Section IV.

Toolbox Material

- Publication "The Surface Irrigation Manual", ITRC, Cal-Poly.
- Video Surface Irrigation / Riego Superficial, "Saving Water in Agriculture", NRCS, New Mexico



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10. Subsurface Irrigation System Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 16 (NEH, Part 624, Water Table Control, in draft).
- FOTG Section IV.

Toolbox Material

- None

11. Contour Ditch Irrigation System Design

Reference Material

- Irrigation Guide, Chapter 6.
- NEH 15.
- FOTG Section IV.

Toolbox Materials

- None



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12. Trickle Irrigation Design

Reference Material

- Industry Videos from Manufacturers & Suppliers.
- NEH 15, Chapter 7.
- Irrigation Guide, Chapter 6.
- FOTG Section IV.

Toolbox Material

- Publication "Drip and Microirrigation for Trees, Vines, and Row Crops", ITRC, Cal-Poly.
- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000

13. PUMPING PLANT DESIGN

Reference Material

- Irrigation Guide, Chapter 6.
- FOTG Section IV.

Toolbox Material

- Publication "The Surface Irrigation Manual", ITRC, Cal-Poly.
- Video "Certified Irrigation Designer's Video Series, Step 2: Pump Selection, Application, and Use", Irrigation Association.
- Publication "Understanding Pumps", Irrigation Association.



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14. Chemigation/Fertigation Design

Reference Material

- Irrigation Guide, Chapter 7.
- FOTG Section IV.
- “General Chemigation/Product Combination”, (Video), Agri Inject Inc.
- “Fertigation”, (Video) International Irrigation Center, Israel.

Toolbox Material

- Publication “The Surface Irrigation Manual”, Cal-Poly IT & RC.
- Publication “Fertigation”, ITRC, Cal-Poly .
- Pub/CD “Managing Irrigation and Nitrogen to Protect Water Quality”.
University of Nebraska Cooperative Extension, EC99-786-S
(Located in the Irrigation System Planning Toolbox)

15. Filtration Design

Reference Material

- FOTG Section IV.

Toolbox Material

- Publication “Drip and Microirrigation for Trees, Vines, and Row Crops”,
Burt, ITRC, Cal-Poly.
- Publication “The Surface Irrigation Manual”, ITRC, Cal-Poly.
- Publication “Sprinkler and Trickle Irrigation”, Jack Keller and Ron D.
Bliesner, Blackburn Press, 2000
- Video “General Filtration for Drip and Microirrigation” , ITRC, Cal-
Poly.
- Video “Sand Media Filtration”, ITRC, Cal-Poly.



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16. Low Energy Precision Application (LEPA)/Low Pressure in Canopy Application (LPIC) System Design

Reference Material

- FOTG Section IV.

Toolbox Material

- Publication "Sprinkler and Trickle Irrigation", Jack Keller and Ron D. Bliesner, Blackburn Press, 2000
- Publication "Sprinkler Irrigation Systems", Midwest Planning Service, MWPS –30, 1999 (Located in the Irrigation System Planning Toolbox)
- Video "LEPA, Saving Water for Future Producers", (in Irrigation System Planning Section).
- DVD "Assuring Efficient Center Pivot Irrigation"

17. Level Basin/Levee Design

Reference Material

- FOTG Section IV.

Toolbox Materials

- Publication "The Surface Irrigation Manual", ITRC, Cal-Poly.
- Video Surface Irrigation / Riego Superficial, "Saving Water in Agriculture", NRCS, New Mexico



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18. Well Design

Reference Material

- FOTG Section IV.
- “Groundwater and Wells”, Johnson Div., UOP Inc.
- “Developing The Ground Water Supply”, D. Barefoot and D. Schwab, Oklahoma State University.

Toolbox Materials

- Video “Module 5 - Principles of Well Location”, Private Rural Well Protection Video Training Series, NRCS.
- Video “Module 6 - Well Design and Construction”, Private Rural Well Protection Video Training Series, NRCS.

19. Tailwater Recovery

Reference Material

- Irrigation Guide, Chapter 7.
- FOTG Section IV.

Toolbox Material

- Publication “The Surface Irrigation Manual”, ITRC, Cal Poly.

Facilitation Options

- Self-paced,
- Facilitator guided, or
- Formal classroom training.



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Evaluation

Each state should develop an evaluation procedure which addresses the level of competence desired before and after training is provided.

Reference Material

- “Agricultural Drainage and Subirrigation Systems, Maumee Valley RC&D”
Defiance, Ohio, 1/94.
- “Managing Agricultural Drainage Waters in Today’s Environment”, 1995,
Overholt Drainage School, Ohio State University, 3/95.
- “Subirrigation and Controlled Drainage”, H.W. Belcher, et.al., Library Of
Congress 94-30888.