Tile Drainage Design  
for Profitability and the Environment

Gary R. Sands  
Professor & Extension Engineer
A New Era of Drainage

Productivity & Profitability

The Environment
Golden Rule of Drainage

Though shalt drain only that which is required to ensure good crop growth and soil trafficability ....
And not a drop more!

R. W. Skaggs
Design Goals

Crop needs
Soil Needs
Hydraulic efficiency
Maintenance-free
Unwanted environmental effects
Management of system
Design Decisions

- Areas to be drained
- Drainage rates (coefficients)
  - Drain depth
  - Drain spacing
- Drain size
- Drain grades
- Drain materials
- Drainage system layout
- Outlet configuration
Golden Rule of Drawing

Two or three days later, in which is
inferred to some good crop growth
and soil fertility
... And not a drop more!

O. L. 1985

Asking Too Much?
We Lack the Tools!

**Minnesota Drainage Guide, NRCS, 1984**
Drainage Coefficient & Spacing?

Diagram showing the effects of drain spacing on crop damage.

- **Good Crops**
  - Drains spaced correctly
  - Drains spaced too far apart, resulting in **Area of Severe Crop Damage**
Drainage Coefficient & Spacing?
Considering Profitability

Benefits

Costs

Profitability
Improve profitability by using smaller drainage coefficients
Crop Yield Response

Webster soil

Waseca

100-yr simulation
Profitability

Webster soil
Waseca
100-yr simulation
IRR
BUT WHAT ABOUT THE ENVIRONMENT?
Considering the Environment

- Surface Runoff & Associated Stuff
- Drainage Volume & Nitrate Loss

- Benefits
- Costs
- Profitability
Drainage Volume

Webster soil
Waseca
100-yr simulation

¾-inch D.C.
⅛-inch D.C.
Profitability vs. Drain Volume

Webster soil
Waseca
100-yr simulation
Surface Runoff

Webster soil

Waseca

100-yr simulation
Tile Design, in Summary...

- Profitability (P) & Environment (E) should both be considered
- Drainage benefits more marginal with narrower spacing
  - Profitability may decrease with ↑ cost
- Subsurface and surface E impacts are opposite, in general
- Increasing P while reducing E may be possible
- Multiple practices to ensure best result
Thank You!

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