

On-Farm Water Budgets

ESHMC Meeting
October 2008

B. Contor

Disclaimer:
All illustrations are
hypothetical cartoons.
I believe they are
conceptually accurate.

The concern

- ESPAM1.1 irrigation calculations use simple algorithms
- Implicit relationships are stepwise linear
- Only three possibilities:
 - supply > ET: Recharge
 - supply = ET: Nothing
 - supply < ET: Pumping
- Recharge is the same for all parcels in a given class (and all parts of a single parcel)

Reality Check



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Let's Examine the Simplifications

- What are our algorithms?
- What is reality?
- How much difference does it make?
- How often does it matter?
- Is there something we can do?

ESPAM1.1 conceptual model (ground water only):

$$\text{In-field Recharge} = (P - ET * A)$$

P = precipitation
ET = Evapotranspiration
A = ET adjustment factor

ESPAM1.1 conceptual model (ground water only):

ET * A

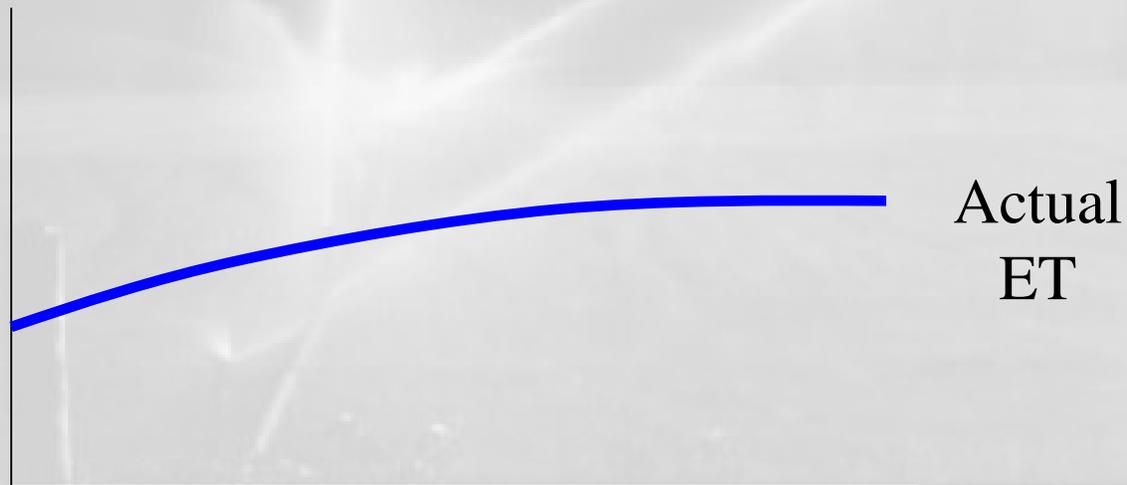


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Calculated Net
Pumpage

7

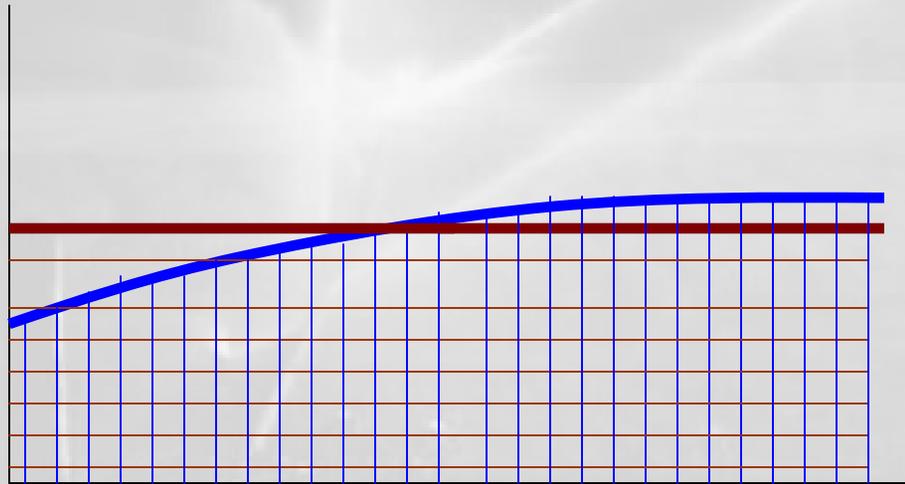
What is reality - ground water only?



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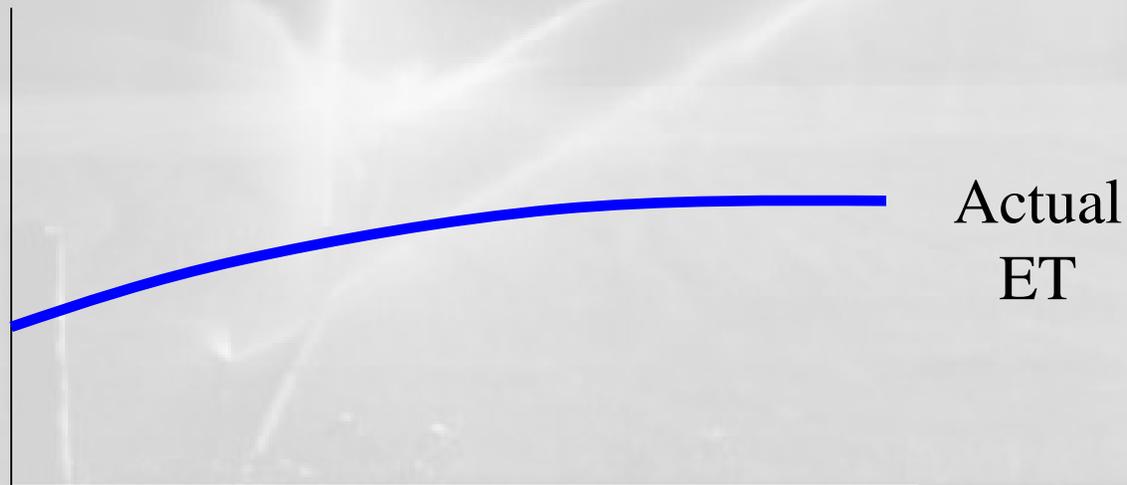
Actual
Net Pumpage

What is reality - ground water only?



*By the very construction of ET Adjustment Factors,
the integrated areas under the curves will be equal.*

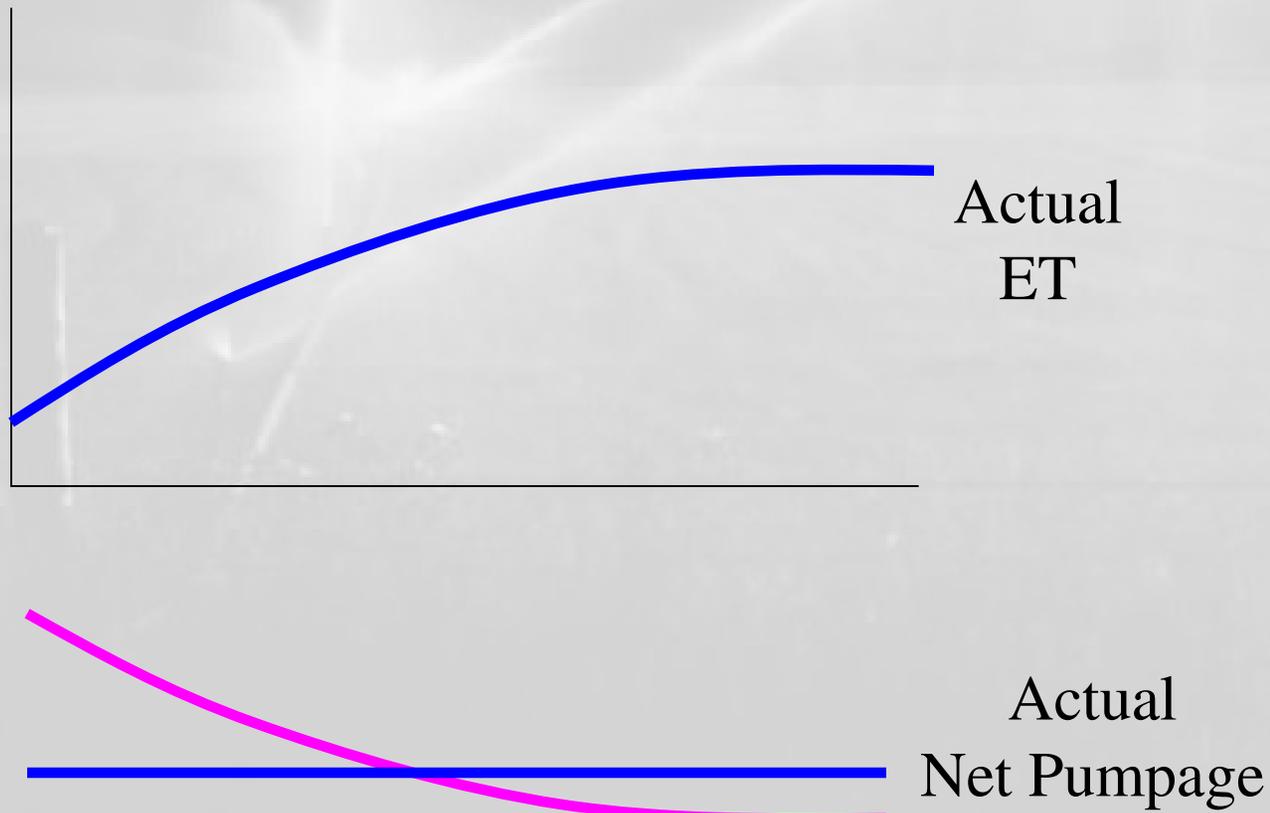
How much difference does it make - ground water only?



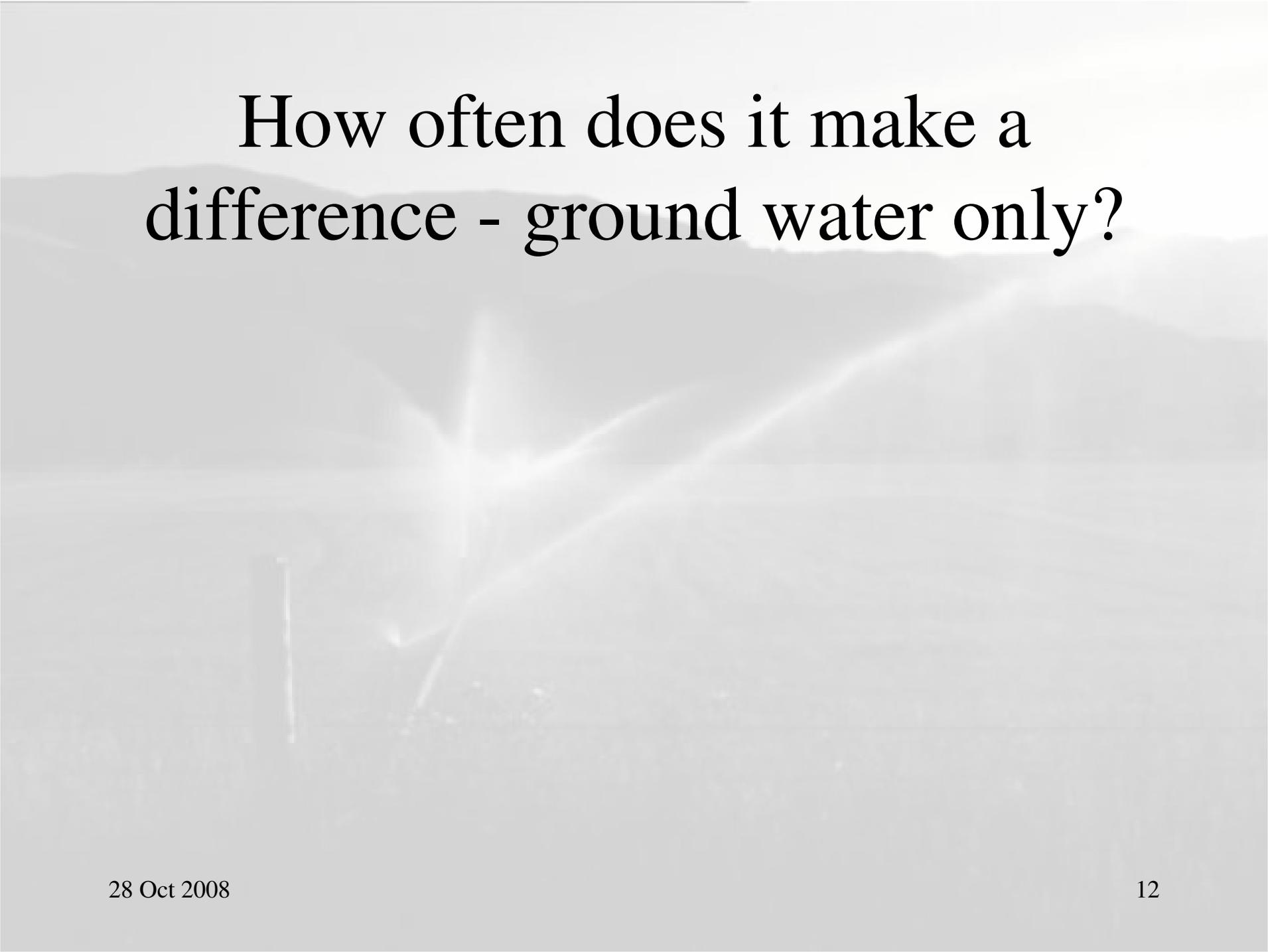
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How much difference does it make - ground water only?



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How often does it make a
difference - ground water only?

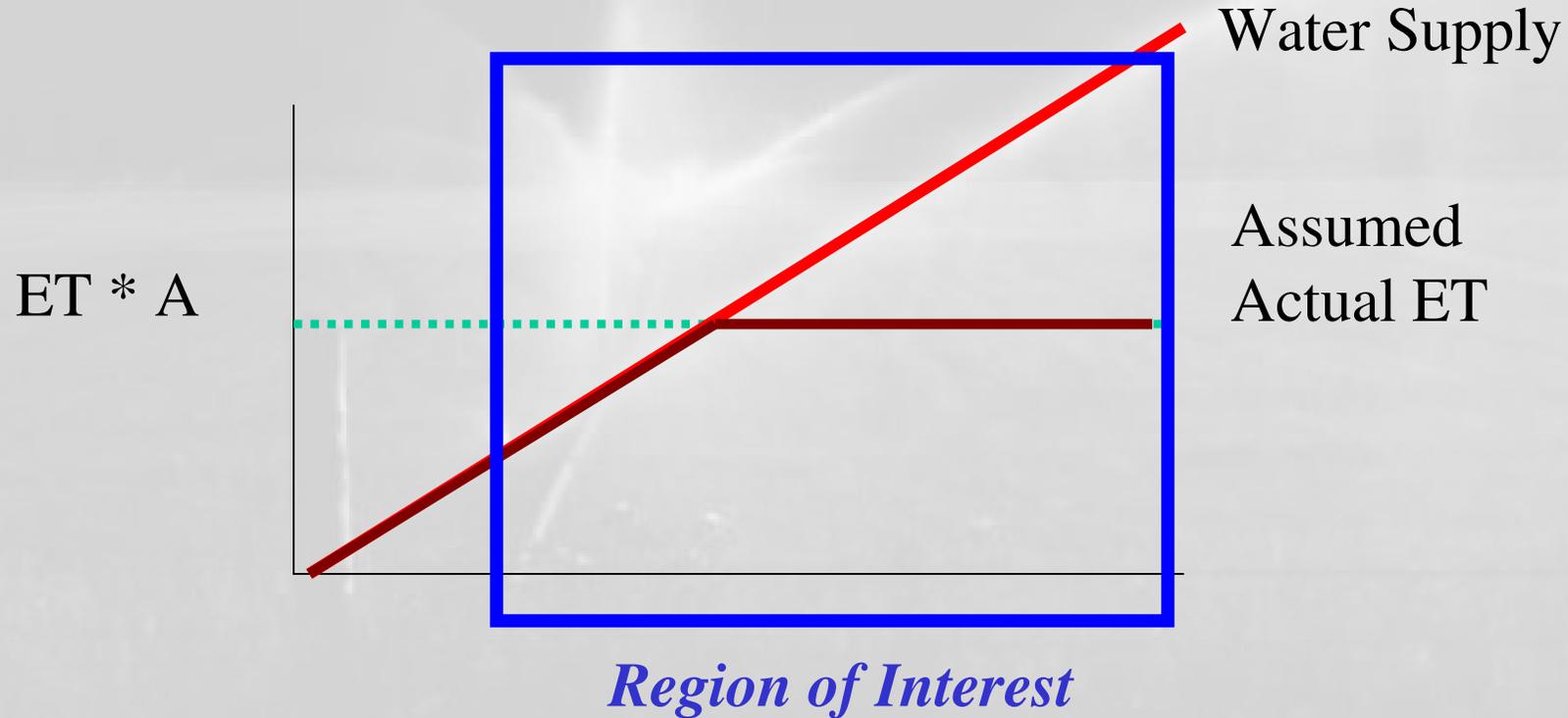
ESPAM1.1 conceptual model (surface water only):

$$\text{In-field Recharge} = \text{Max}^* (P + D_h - R - ET * A, 0)$$

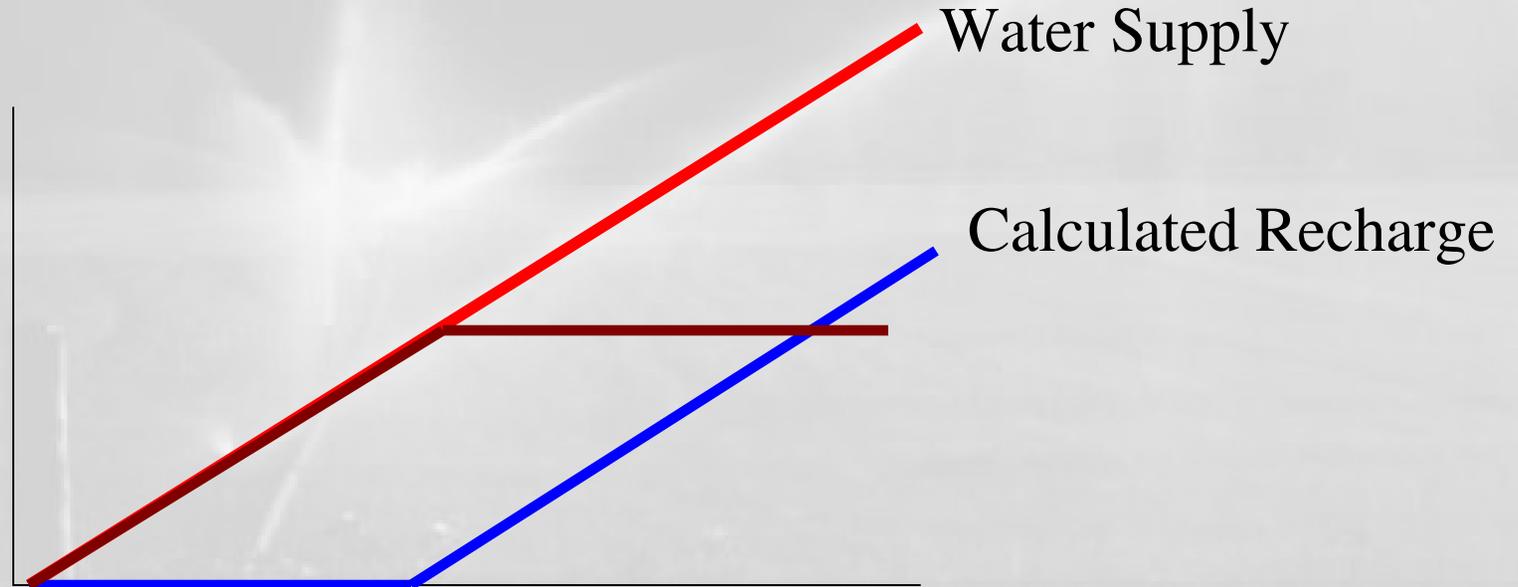
- P = precipitation
- D_h = field headgate delivery
- R = runoff from field
- ET = Evapotranspiration
- A = ET adjustment factor

* (manual adjustment)

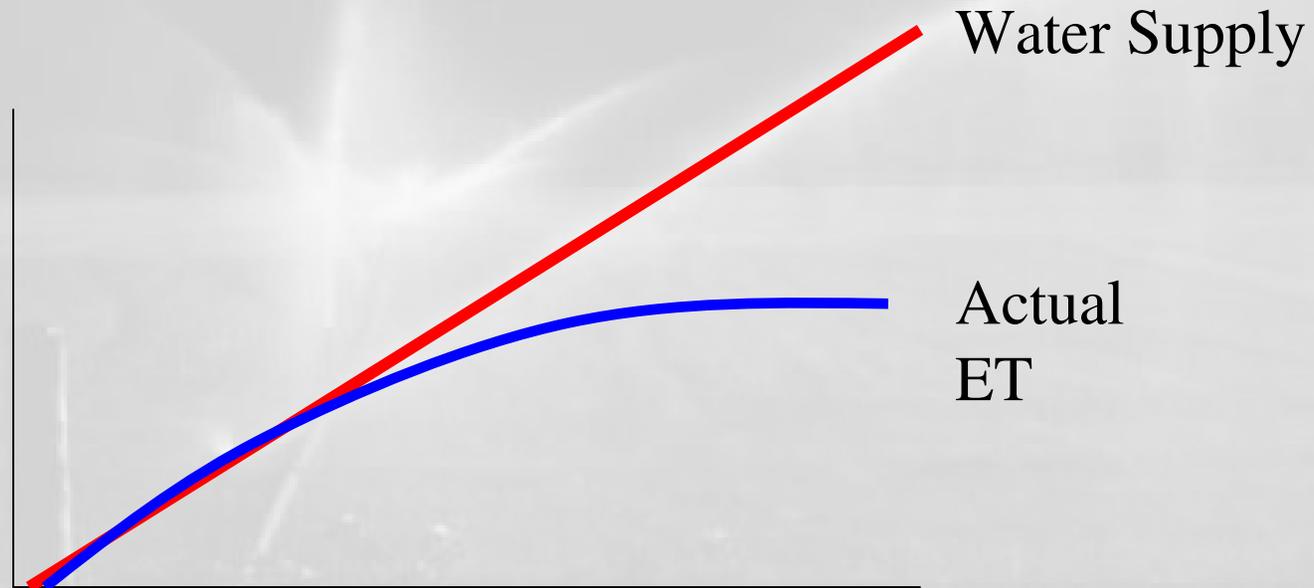
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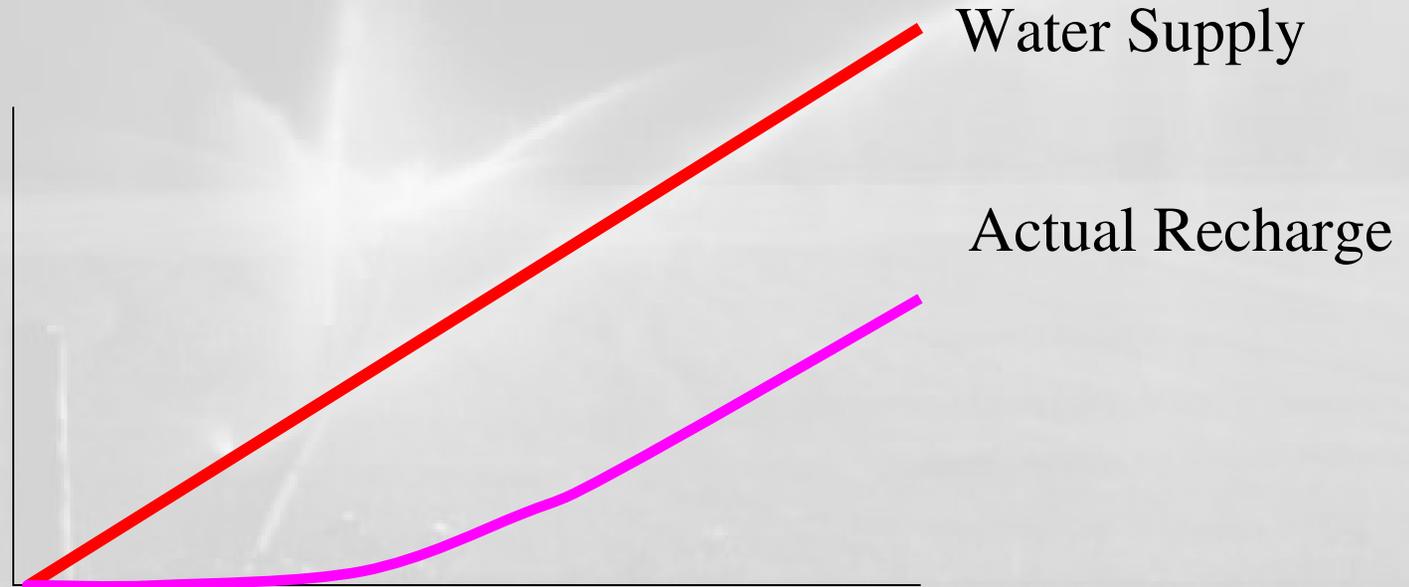
ESPAM1.1 conceptual model (surface water only):



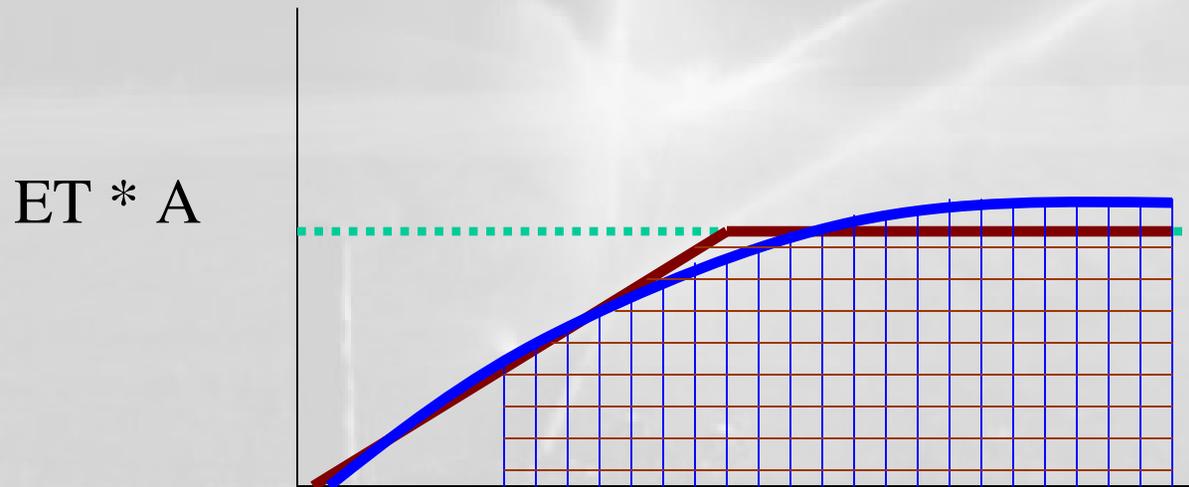
What is reality - SW only?



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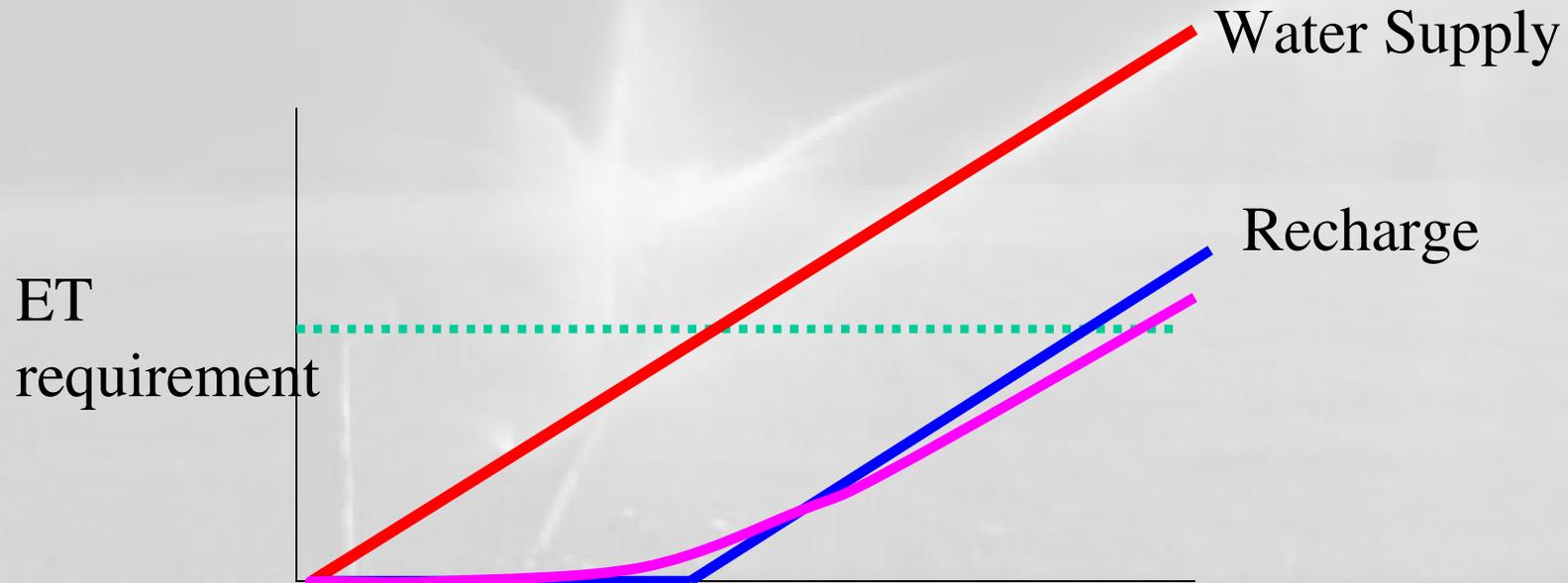


What is reality - SW only?

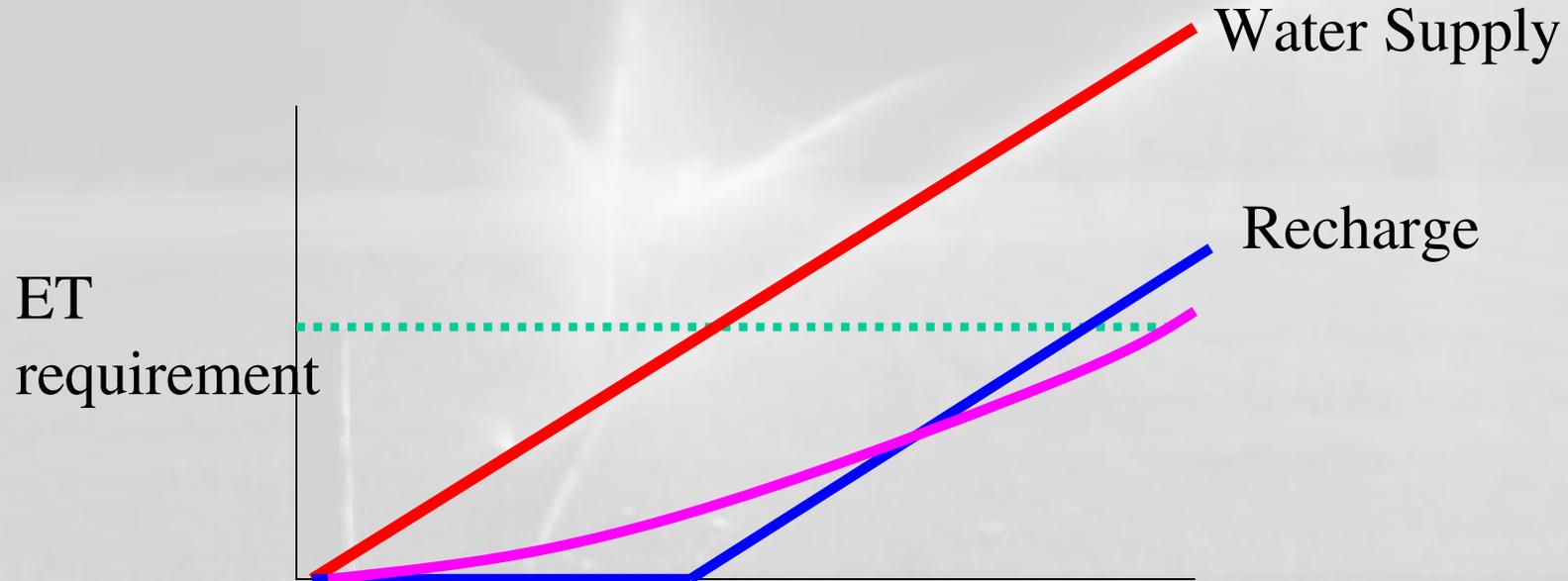


*By the very construction of ET Adjustment Factors,
the integrated areas under the curves will be equal.*

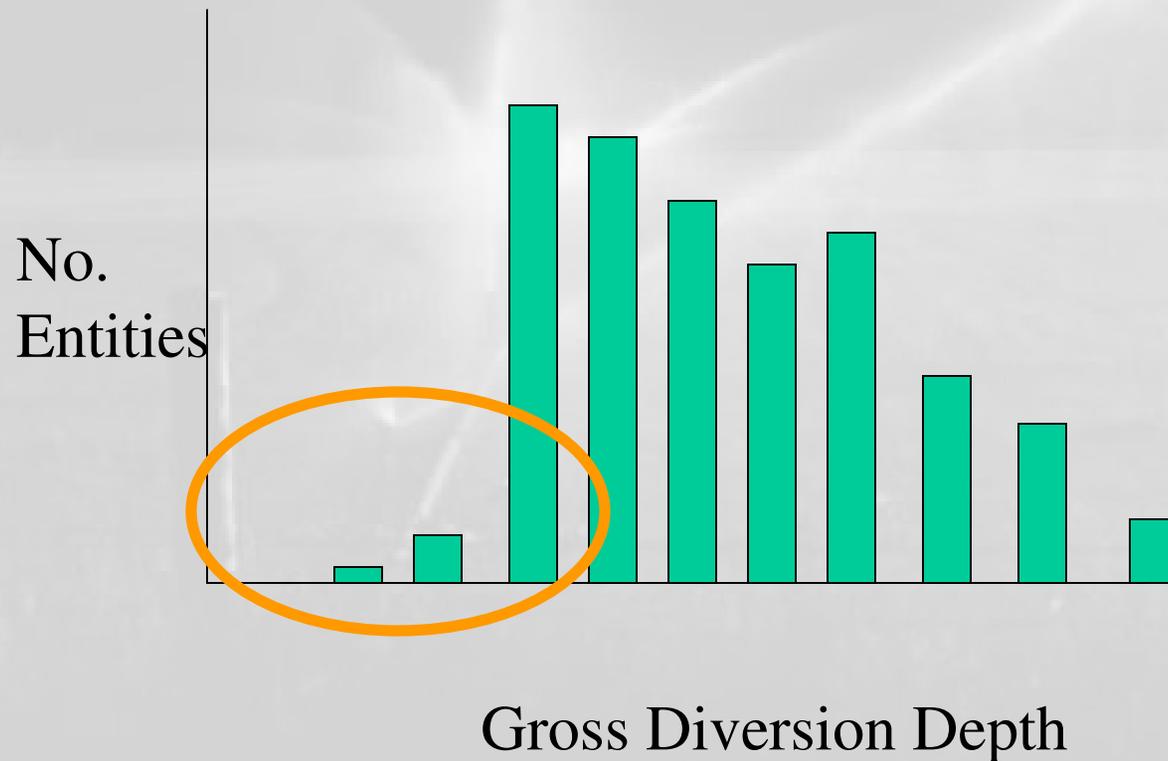
How much difference does it make - SW only?



How much difference does it make - SW only?



How often does it make a difference - SW only?



ESPAM1.1 conceptual model (mixed source):

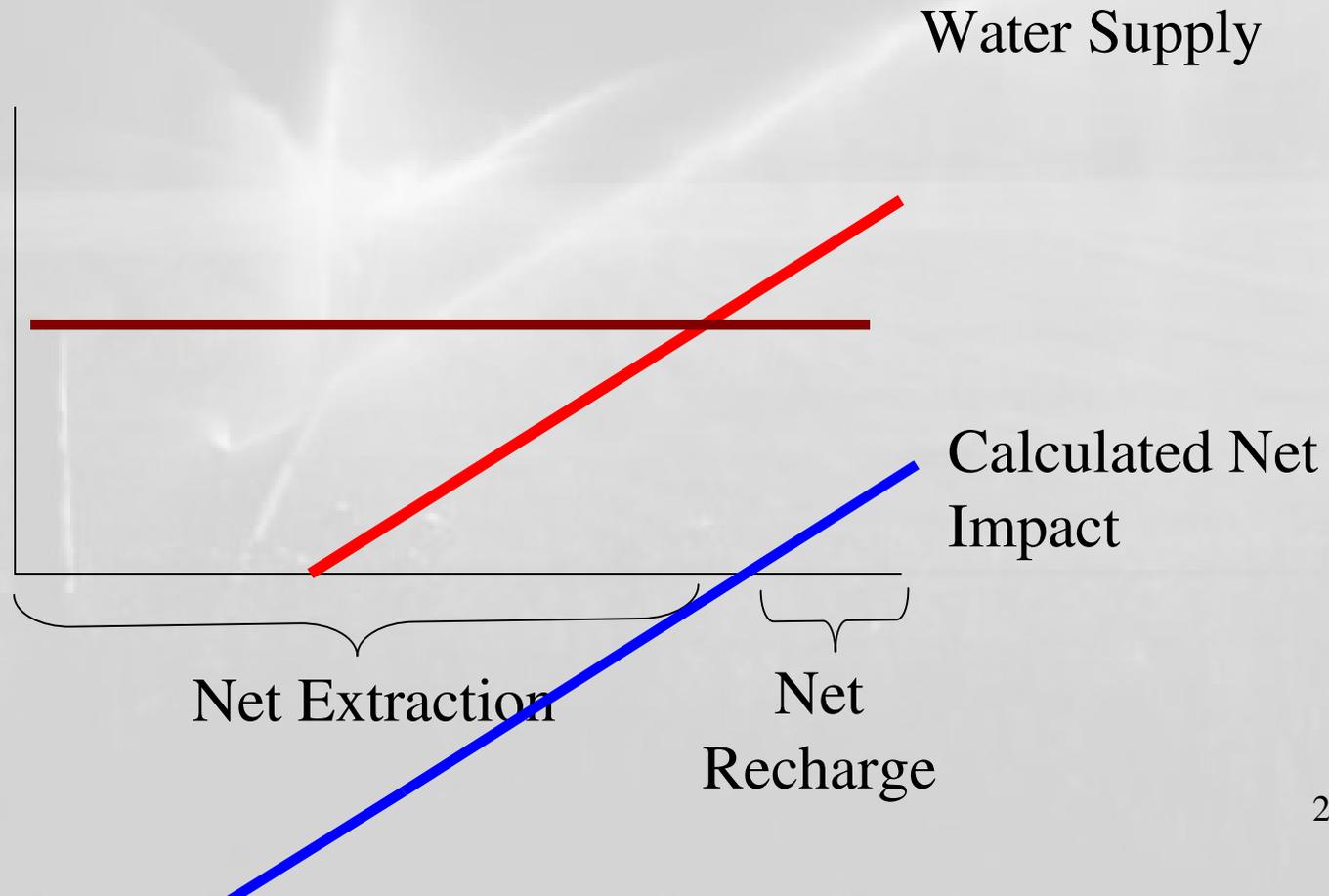
$$\text{In-field Recharge} = (P + D_h - R - ET * A)$$

- P = precipitation
- D_h = field headgate delivery
- R = runoff from field
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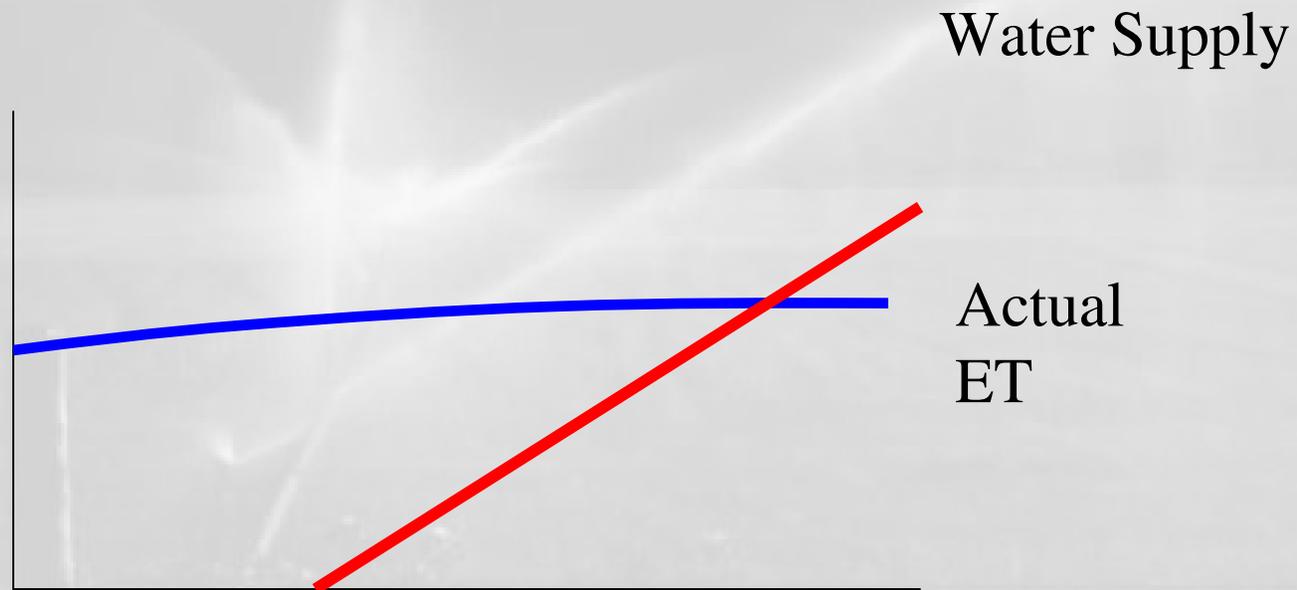
ESPAM1.1 conceptual model (mixed source):



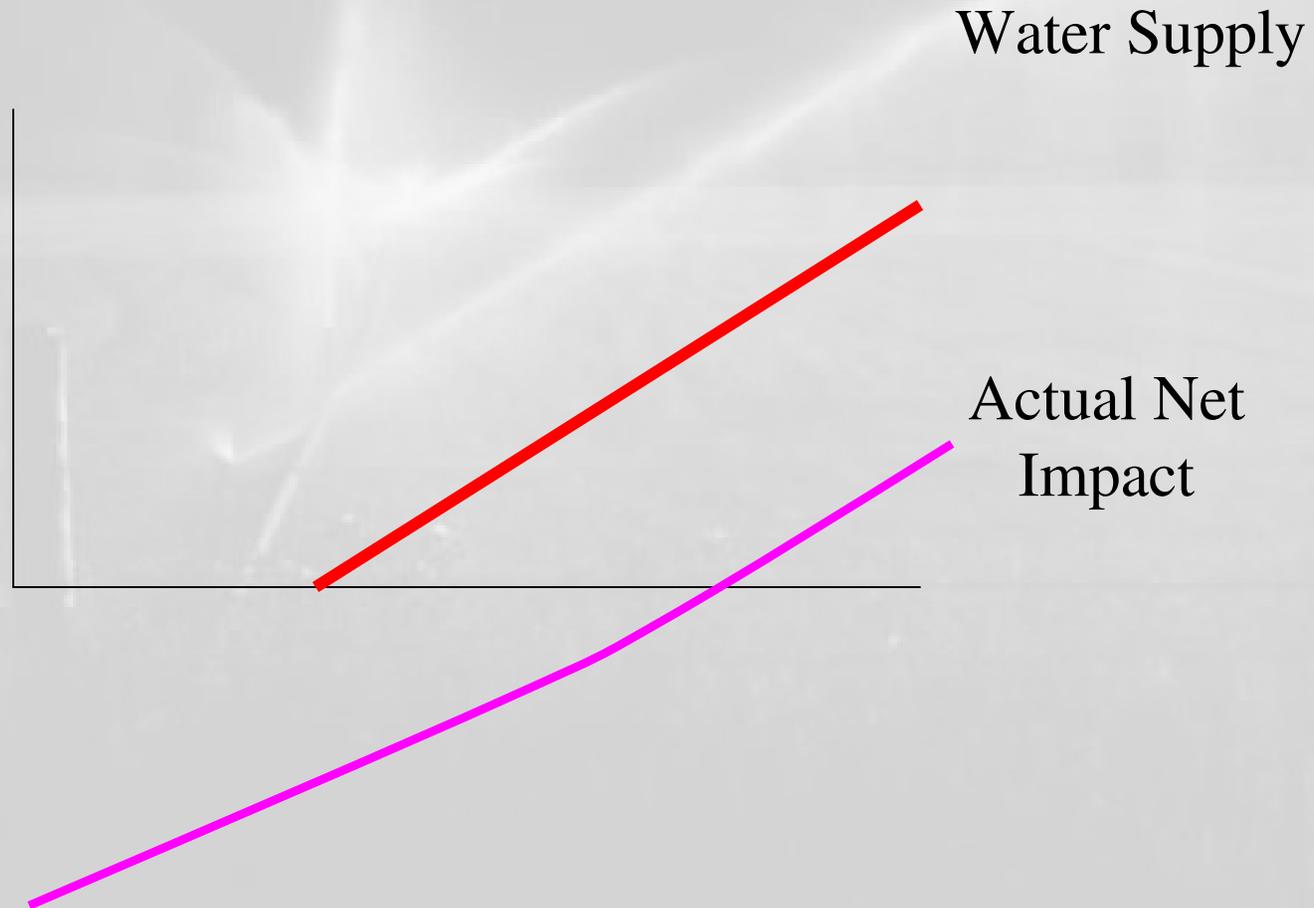
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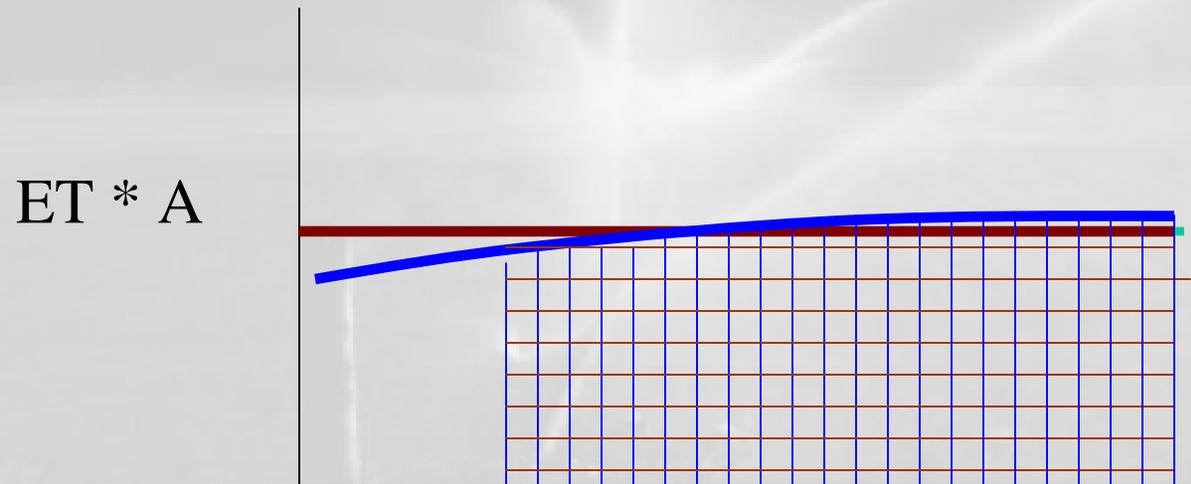
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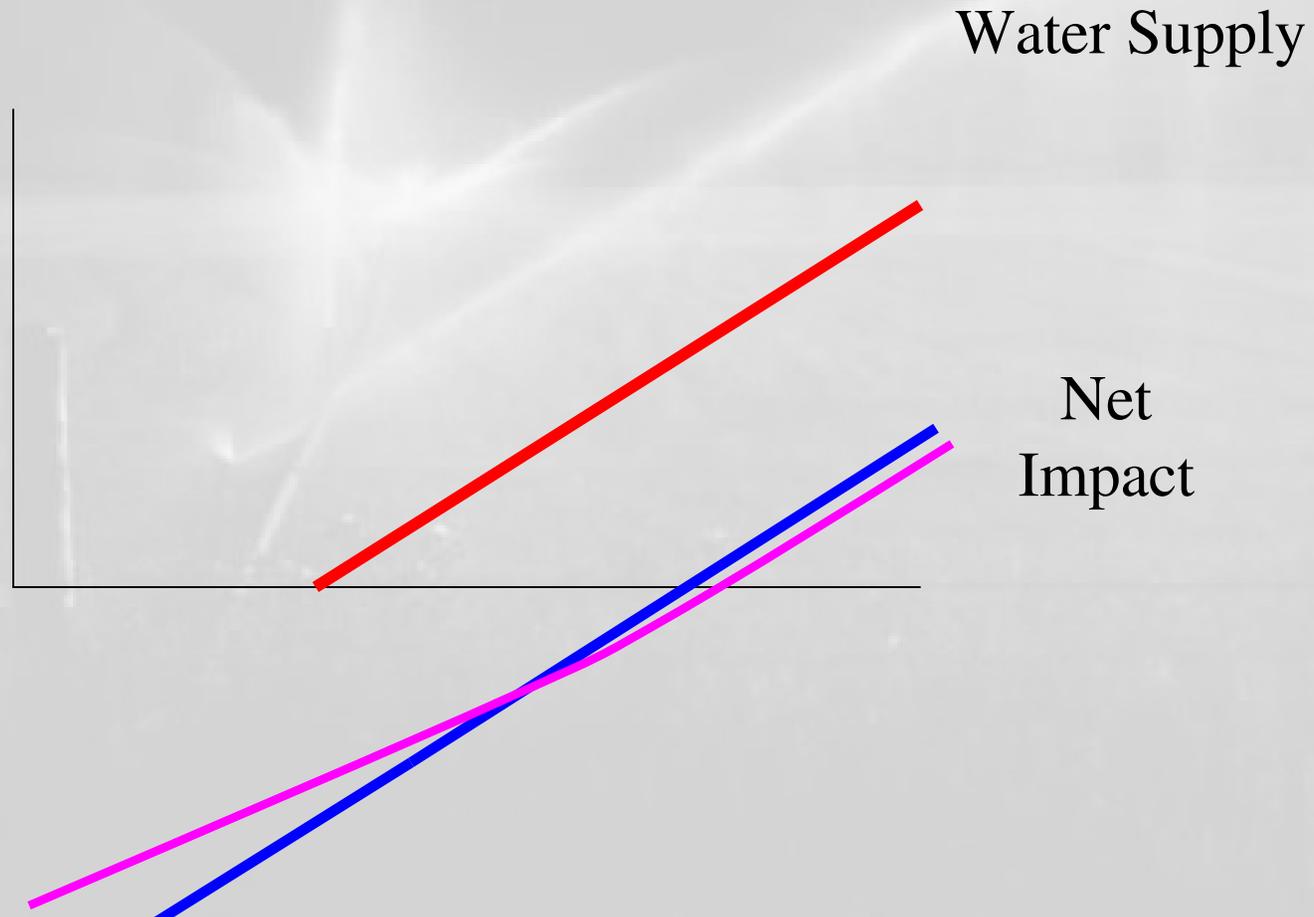


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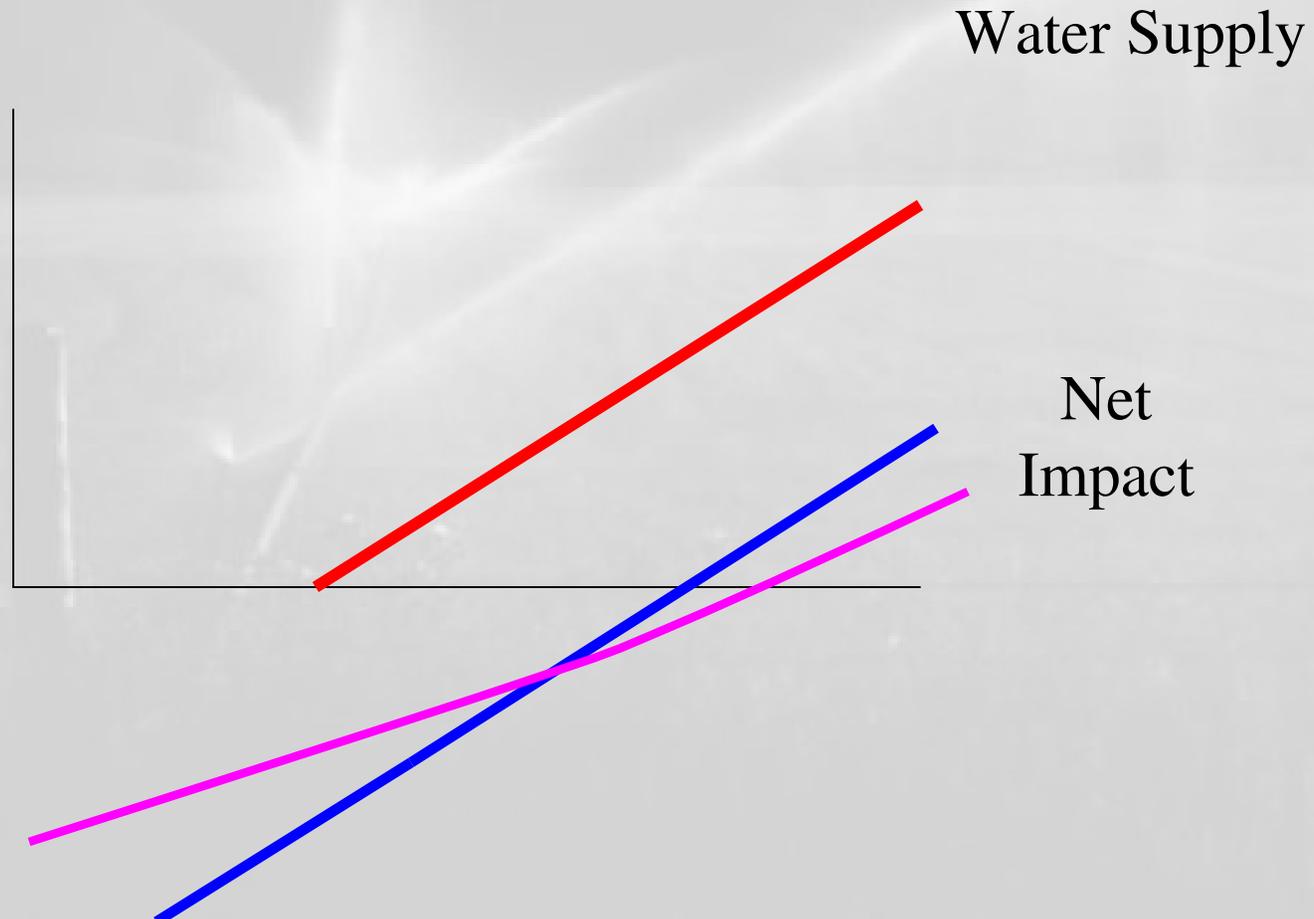


*By the very construction of ET Adjustment Factors,
the integrated areas under the curves will be equal.*

How much difference does it make - mixed source?



How much difference does it make - mixed source?





How often does it make a
difference on mixed-source
lands?

Bottom Line:

Avg. Model Net Effect = Avg. Actual Net Effect

if

we get ET Adjustment Factor right.

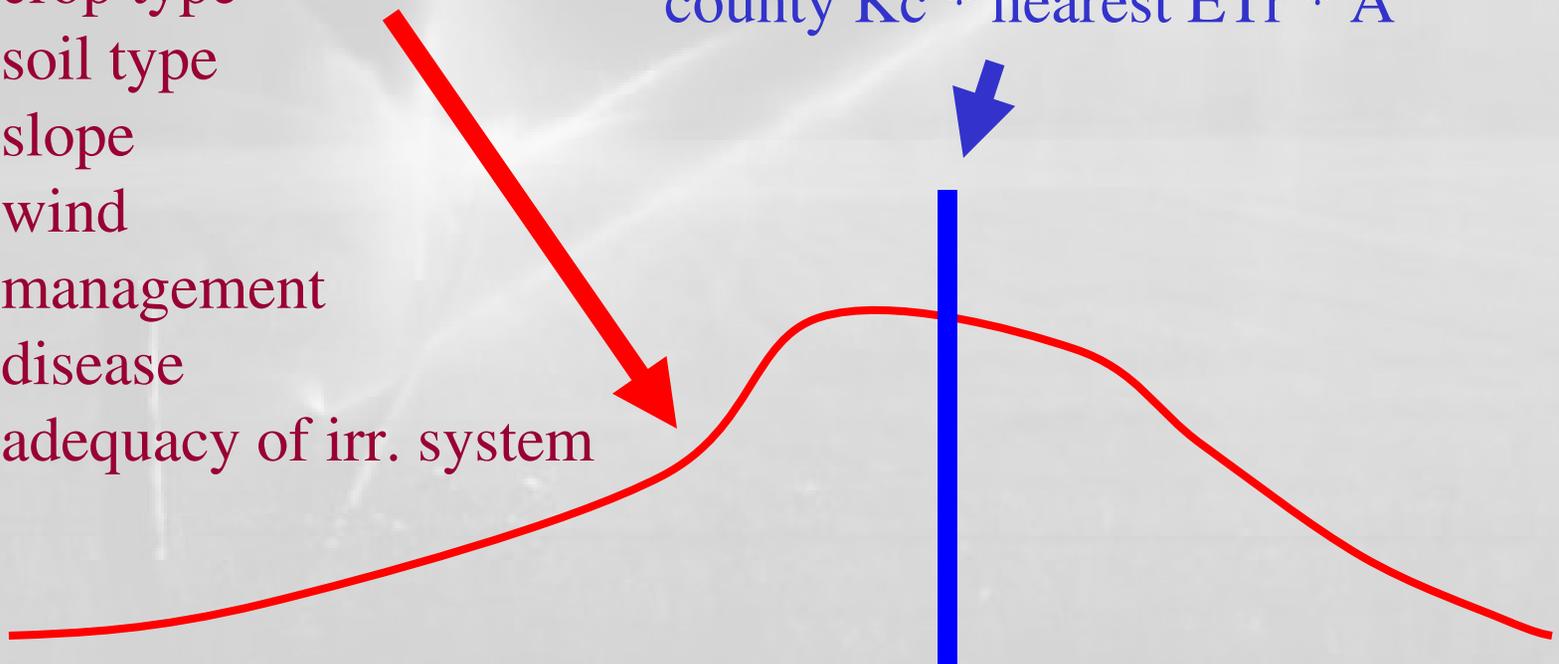
There may be some distortion
in spatial distribution of recharge

For context, consider other spatial uncertainties in ET:

probability distribution:

crop type
soil type
slope
wind
management
disease
adequacy of irr. system

county K_c * nearest E_{Tr} * A



Is there something we can do?

- Accept status quo
- Make minor revision
 - In-field Rech = Max (P + D_h - R - ET*A, X)
 - X to be defined by ESHMC
 - $0 < X < (P + D_h - R)$ ← *Introduce Bias?*
- Make major revision
 - On-farm water budget study for sampling of farms
 - Modify algorithm

On-farm Water Budgets

Irrigation Water Requirements

Part 623
National Engineering Handbook

**623.0209 Irrigation
efficiencies**

THE SURFACE IRRIGATION MANUAL

A Comprehensive Guide
to Design and Operation
of Surface Irrigation Systems

FIRST EDITION

1995

By

DR. CHARLES M. BURT

Published by:
Waterman INDUSTRIES, INC.
P. O. Box 458 - 25500 Road 204
Exeter, Ca 93221

National
Engineering
Handbook

Irrigation

Chapter 5
(Second Edition)

Furrow

ESTIMATION OF GLOBAL IRRIGATION DISTRIBUTION UNIFORMITY

By A. J. Clemmens¹ and K. H. Solomon,² Members, ASCE

ABSTRACT: For most irrigation systems, the most practical method for determining the global distribution uniformity (i.e., that experienced by the entire crop) is to measure the uniformity resulting from several components and combine them statistically. In this paper, procedures and equations are presented for determining global distribution uniformity from several components. Distribution uniformity is defined in terms of extreme values in the distribution, representing some fraction of the field area (e.g., low quarter). The equations and procedures provided herein apply regardless of the size of the area under consideration (e.g., low quarter, low half, etc.), and whether the low or high values are of concern. Procedures and equations for estimating the accuracy of these estimates are also provided.

IRRIGATION PERFORMANCE MEASURES: EFFICIENCY AND UNIFORMITY

Book 12

By C. M. Burt,¹ A. J. Clemmens,² T. S. Strelkoff,³ K. H. Solomon,⁴ R. D. Bliesner,⁵
L. A. Hardy,⁶ T. A. Howell,⁷ Members, ASCE, and D. E. Eisenhauer⁸

ABSTRACT: It is essential to standardize the definitions and approaches to quantifying various irrigation performance measures. The ASCE Task Committee on Defining Irrigation Efficiency and Uniformity provides a comprehensive examination of various performance indices such as irrigation efficiency, application efficiency, irrigation sagacity, distribution uniformity, and others. Consistency is provided among different irrigation methods and different scales. Clarification of common points of confusion is provided, and methods are proposed whereby the accuracy of numerical values of the performance indicators can be assessed. This issue has two companion papers that provide more detailed information on statistical distribution uniformity and the accuracy of irrigation efficiency estimates.

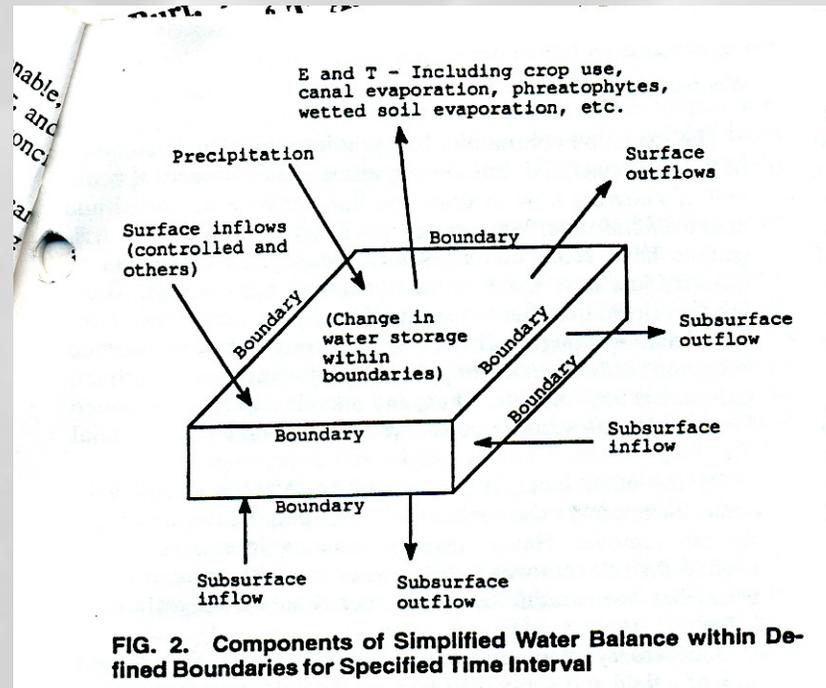


FIG. 2. Components of Simplified Water Balance within Defined Boundaries for Specified Time Interval

Fig. 3 shows a deficit irrigation through

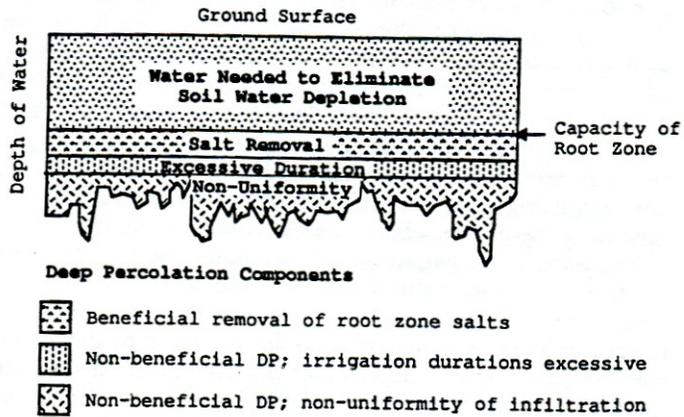


FIG. 4. Overirrigated Field: Beneficial and Nonbeneficial DP

JOURNAL OF IRRIGATION A

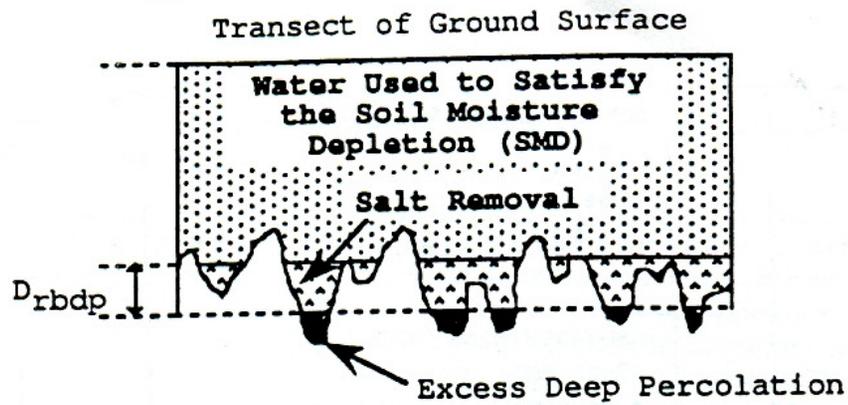


FIG. 5. Deficit Irrigation Nonbeneficial DP

Modified Algorithm?

$$R = B_0 + B_1 X_1 + B_2 X_2 \dots\dots$$

DISCUSSION

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