Brent Mecham
How to Efficiently Manage Irrigation Using BMPs

Brent Mecham, CID, CLWM, CAIS, CIC, CLIA
Irrigation Association
Collaboration between ASIC & IA BMP & Practice Guidelines

- Design
- Installation
- Management

Appendices

- Inspection & Commissioning
- Water Budgeting
- Scheduling

www.irrigation.org/landscapebmps
OUR STAMP ON THE FUTURE
Through Technology, Best Practices and Awareness
Basis of Design [BOD]

Written narrative describing how the irrigation system will meet the functional purposes of the project owner.

How does the irrigation system contribute to water use efficiency and sustainability.
Installation
• Qualified contractors
  • Who are they?
  • How do they prove they are qualified
  • What is the right price?

• WIIFM
  • Inspections
  • Functional performance testing
  • Commissioning
Management

- Communicate
- Evaluate
- Monitor
- Budget
- Schedule
- Maintain
\[ \text{WR}_{H} = \frac{((\text{ET}_{o} \times \text{PF}) - \text{R}_{e}) \times \text{LA} \times 0.623}{\text{IE}} \]
Trip Pin
Empty Slots
Day wheel advance do not move!
measure
to manage
• Inspections
• Functional performance testing
• Commissioning [Cx]
Technology
Distribution

Energy
Discussion or Questions?
Turfgrass Water Conservation and Irrigation Efficiency

Bernd Leinauer
Professor & Extension Turfgrass Specialist
New Mexico State University
Turfgrass Irrigation Requirement
Las Cruces, NM (2005 – 2009)

- ETo
- Precipitation
- Warm-Season
- Cool-Season
# Turfgrass Irrigation

## Las Cruces

<table>
<thead>
<tr>
<th>Grass Type</th>
<th>1500 ft²</th>
<th>700 ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS</td>
<td>35,500 gal</td>
<td>16,560 gal</td>
</tr>
<tr>
<td>CS</td>
<td>46,700 gal</td>
<td>21,790 gal</td>
</tr>
</tbody>
</table>

## GCSAA Survey (Gelernter et al., 2015)

- Cool-season: 50”
- Warm-season: 38”
- Total Irrigation: 46.4”
Ecosystem Services: Mitigation of Heat Islands

- Trees and vegetation lower surface and air temperatures
- Shaded surfaces may be 11–25°C (20–45°F) cooler than the peak temperatures of unshaded materials
- Evapotranspiration, alone or in combination with shading reduces peak summer temperatures by 1–5°C (2–9°F)
Strategies for Irrigation Water Conservation

1. Artificial Turf
2. **Reduce area under irrigation**
3. Irrigation with recycled/impaired water
4. Use of low water use **turfgrass species**
5. Accept quality reduction
6. Increase irrigation efficiency

I. **Scheduling**
   a) Climate data
   b) Soil water status

II. **Improve Water Distribution**
Turf removal

• $3.75/ft²

• Install a new landscape:
  ➢ no live turf or turf looking plants
  ➢ includes plants (no turf)

• synthetic turf may be eligible

http://socalwatersmart.com
Strategies for Irrigation Water Conservation

1. Artificial Turf
2. Reduce area under irrigation
3. Irrigation with recycled/impaired water
4. Use of low water use turfgrass species
5. Accept quality reduction
6. Increase irrigation efficiency

I. Scheduling
   a) Climate data
   b) Soil water status

II. Improve Water Distribution
Irrigation with Recycled/Alternative Water
# Water Quality Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Ground Water</th>
<th>Recycled Water</th>
<th>Sea Water</th>
<th>CBM Water (47 Wells)</th>
<th>potable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>El Paso</td>
<td>Las Cruces</td>
<td>Carlsbad, NM</td>
<td>CA</td>
<td>Las Cruces</td>
</tr>
<tr>
<td>pH</td>
<td>7.8</td>
<td>6.4</td>
<td>7.3</td>
<td>7.7</td>
<td>7.0</td>
</tr>
<tr>
<td>EC</td>
<td>2.6</td>
<td>1.1</td>
<td>4.0</td>
<td>6.4</td>
<td>2.0</td>
</tr>
<tr>
<td>TDS</td>
<td>1,644</td>
<td>710</td>
<td>2,560</td>
<td>3,925</td>
<td>1,266</td>
</tr>
<tr>
<td>SAR</td>
<td>11.5</td>
<td>5.2</td>
<td>10.5</td>
<td>6.4</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Data from Assadian, 2006; Asano et al., 1985; Duncan et al., 2009, and Rice et al., 2000
Salinity Tolerance

Shoot saline ion exclusion central to salinity tolerance

- **Salt sensitive plants:** accumulate saline ions to toxic levels
- **Salt tolerant plants:** excrete excess saline ions from shoots
Correcting salinity problems

Remediate sodic vs. saline soils

1) Sodic soils
   • Basic (pH > 7)
     o Stabilize structure through Gypsum (CaSO₄)
     o Acidify irrigation water (e.g. synthetic acid, sulfuric acid)
   • Acid (pH < 7)
     o Adding lime (CaCO₃ / MgCO₃)

2) Saline soils

1) Leaching
2) Improve Drainage (Surfactant)
Managing Sodic Soils

Gypsum

$\text{Ca}^{++}\text{SO}_4^-=\text{Ca}^{++}\text{SO}_4^-$

$\text{Na}^+\text{SO}_4^-=\text{Na}^+\text{SO}_4^-$

$\text{Na}^+\text{SO}_4^-=\text{Na}^+\text{SO}_4^-$
• Chamizal National Memorial
• 140 ha irrigated turf area, El Paso, TX
• 46 years irrigated with saline groundwater
• EC = 1.1 dS m$^{-1}$; SAR = 5.2
Relationship between irrigation system uniformity and soil salinity

\[ R^2 = 0.9171 \]
\[ R^2 = 0.9173 \]
Alternate Water Sources and How They Impact the Landscape

In an arid or semi-arid environment, alternate water sources generally have a higher salinity and sodicity than traditional sources:

1. Select salt tolerant plants
2. Correct salinity problems
   a) Reduce salt inputs
   b) Remediate saline/sodic soils:
      Control calcium and sodium to avoid structural problems
   c) Avoid soil amendments that increase moisture retention
3. High irrigation system uniformity
Strategies for Irrigation Water Conservation

1. Artificial Turf
2. Reduce area under irrigation
3. Irrigation with recycled/impaired water
4. Use of low water use turfgrass species
5. Accept quality reduction
6. Increase irrigation efficiency

I. Scheduling
   a) Climate data
   b) Soil water status
II. Improve Water Distribution
Turfgrass Irrigation Requirement

\[ IR = \sum (A, ETo, ISe, Wq, Kc) f(Kc) \]  

- **A**: Area under irrigation  
- **ETo**: reference Evapotranspiration  
- **ISe**: Irrigation System Efficiency  
- **Wq**: Water Quality  
- **Kc**: Crop coefficient

<table>
<thead>
<tr>
<th>IR</th>
<th>Irrigation Water Use &gt; Irrigation Water Requirement</th>
</tr>
</thead>
</table>

- **SP**: Species  
- **TQ**: Turf quality  
- **GDD**: Growing Degree Days  
- **PAW**: Plant available water  
- **Mi**: Management Intensity
Mean Summer Evapotranspiration Rates of Different Turf Species

<table>
<thead>
<tr>
<th>ET rate</th>
<th>Cool season</th>
<th>Warm season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in/wk</td>
<td>mm/day</td>
</tr>
<tr>
<td>2.0 – 3.5</td>
<td>7.2 – 12.6</td>
<td>Tall Fescue</td>
</tr>
<tr>
<td>1.8 – 3.1</td>
<td>6.6 – 11.2</td>
<td>Perennial ryegrass</td>
</tr>
<tr>
<td>1.7 – 2.2</td>
<td>6.2 – 8.1</td>
<td>Seashore paspalum</td>
</tr>
<tr>
<td>1.6</td>
<td>5.7</td>
<td>Blue grama</td>
</tr>
<tr>
<td>1.5 – 2.0</td>
<td>5.3 – 7.3</td>
<td>Buffalograss</td>
</tr>
<tr>
<td>1.0 – 2.2</td>
<td>4.0 – 8.7</td>
<td>Bermudagrass</td>
</tr>
<tr>
<td>1.3 – 2.1</td>
<td>4.8 – 7.6</td>
<td>Zoysiagrass</td>
</tr>
<tr>
<td>1.1 – 1.8</td>
<td>4.1 – 6.6</td>
<td>Kentucky bluegrass</td>
</tr>
</tbody>
</table>

Gaussoin, 2003
Buffalograss - Water Use
(Stewart et al., 2004)

• No difference in water extraction between buffalograss and Kentucky bluegras for well watered conditions

Incipient water stress:
• Kentucky bluegrass depleted 50% of soil water to 30 cm depth (6 days)
• Buffalograss depleted 60% of soil water to 90 cm depth (20 days)
Irrigation Water Requirement (1)

• Historically, ET rates determined under non-limiting moisture conditions.

• A wide range of ET (within and between species) indicates that water use is affected by many factors, e.g. soil moisture availability and quality expectations.

• Consequently, in the context of water conservation, the question is not how much water do turfgrasses use, but what is the minimum amount of water they require to survive and meet desired quality expectations.

• Deficit irrigation → Kc.
Irrigation Water Requirement (2)

- Deficit irrigation is only effective if turf areas receive sufficient rainfall to occasionally recharge the soil profile (Shearman 2008).
- When occasional natural precipitation is insufficient, drought periods need to be followed by periodic increased irrigation amounts for grasses to recover (Baird, et al., 2009; Devitt and Morris, 2008).
- The main drought resistance mechanism from a lack of sufficient irrigation may be dormancy which results in a loss in color and cover.
Study

- 5 Species:
  Bermudagrass (3), Buffalograss (2), Kentucky bluegrass (8), Perennial ryegrass (7), Tall fescue (10)
- 5 ETos levels:
  1.15, 1.0, 0.85, 0.7, 0.55
- 3 Years:
  2013 – 2015
- Data:
  Visual quality, Green Cover, NDVI
CS Turfgrass Quality Summer 2014
CS Turfgrass Quality Summer 2015
Conclusion

1) Traditional cool season grasses may perform adequately even with less water than historically been thought

2) “high water use grasses” may perform equally acceptable than “low water use grasses” even at the same reduced amount of irrigation

3) In order to make useful recommendations, regional testing under water limiting conditions is necessary

4) Consider additional stresses, e.g. salinity, traffic
Strategies for Irrigation Water Conservation

1. Artificial Turf
2. Reduce area under irrigation
3. Irrigation with recycled/impaired water
4. Use of low water use turfgrass species
5. Accept quality reduction
6. Increase irrigation efficiency

I. Scheduling
   a) Climate data
   b) Soil water status

II. Improve Water Distribution
Results

Tall Fescue

- 37%

Cumulative ETo
XTRA Smart Sensor
Climate Logic
Constant
ET 90

Irrigation (mm)

Strategies for Irrigation Water Conservation

1. Artificial Turf
2. Reduce area under irrigation
3. Irrigation with recycled/impaired water
4. Use of low water use turfgrass species
5. Accept quality reduction
6. Increase irrigation efficiency

I. Scheduling
   a) Climate data
   b) Soil water status
II. Improve Water Distribution
Irrigation Efficiency

• Mecham (2004): Summary of uniformity data from over 6800 irrigation audits (Utah, Nevada, Colorado, Arizona, Texas, Oregon, and Florida)

• Average DU of 0.5

The amount of irrigation water doubles compared to what “the grass plant needs” to maintain an adequate quality level.
**PLD-ESD**

**XFS Subsurface Dripline**

- Water placed precisely where you need it – at the root zone.
- Traffico root inhibitor keeps roots out and water flowing.
- Pressure regulation for uniform application from each emitter.
- Live evaporation rates and never affected by the wind.
Conclusions

1) Subsurface drip irrigation can be used to irrigate turf efficiently
2) also in combination with saline water
3) is a viable alternative to traditional sprinkler systems if installed, monitored, and maintained properly
4) More education and public outreach needed to promote technology
Irrigation effect on brown patch (Rhizoctonia sp.) occurrence

SDI

Sprinkler

SDI

Sprinkler
3 years of potable irrigation @ 50% ET₀
Las Campanas, NM

Problem:
# Las Campanas

<table>
<thead>
<tr>
<th>Course</th>
<th>Tee</th>
<th>Product</th>
<th>Area (ft²)</th>
<th>Spacing</th>
<th>Emitter (gal/hour)</th>
<th>Emitter #</th>
<th>Delivery/hour (gal)</th>
<th>Delivery/hour (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunrise</td>
<td>5</td>
<td>Toro</td>
<td>746</td>
<td>9</td>
<td>0.5</td>
<td>995</td>
<td>1990</td>
<td>0.80</td>
</tr>
<tr>
<td>Sunrise</td>
<td>11</td>
<td>Rainbird</td>
<td>314</td>
<td>12</td>
<td>0.42</td>
<td>314</td>
<td>748</td>
<td>0.67</td>
</tr>
<tr>
<td>Sunrise</td>
<td>13</td>
<td>Toro</td>
<td>236</td>
<td>12</td>
<td>0.5</td>
<td>236</td>
<td>472</td>
<td>0.8</td>
</tr>
<tr>
<td>Sunrise</td>
<td>14</td>
<td>Rainbird</td>
<td>324</td>
<td>12</td>
<td>0.42</td>
<td>324</td>
<td>771</td>
<td>0.67</td>
</tr>
<tr>
<td>Sunrise</td>
<td>14</td>
<td>Control</td>
<td>503</td>
<td>DU=0.79</td>
<td></td>
<td></td>
<td></td>
<td>0.98</td>
</tr>
<tr>
<td>Sunset</td>
<td>6</td>
<td>Rainbird</td>
<td>760</td>
<td>9</td>
<td>0.42</td>
<td>1013</td>
<td>2412</td>
<td>0.67</td>
</tr>
<tr>
<td>Sunset</td>
<td>15</td>
<td>Control</td>
<td>590</td>
<td>DU=0.68</td>
<td></td>
<td></td>
<td></td>
<td>1.51</td>
</tr>
<tr>
<td>Sunset</td>
<td>18</td>
<td>Toro</td>
<td>375</td>
<td>12</td>
<td>0.5</td>
<td>375</td>
<td>750</td>
<td>0.8</td>
</tr>
</tbody>
</table>
References (1)

References (2)


- Schiavon, M., M. Serena, R. Sallenave, B. Leinauer, and J. Baird. IN PRESS. Seeding date and irrigation system effects on establishment of warm-season turfgrasses. *Agronomy Journal*.

Acknowledgements

leinauer@nmsu.edu

@NuMex_Turf
Rob Welke
Water Efficiency vs Energy Efficiency
What’s the Nexus?

Water Efficiency vs Energy Efficiency
What’s the Nexus?

SPONSOR
- Hong Kong Based, Global reach
- Not-for-Profit
- Integrated Community Development
- Environmental clean-up
- Waste water treatment
- Energy efficiency

△ ASIC 2017 NATIONAL CONFERENCE
Water Efficiency vs Energy Efficiency
What’s the Nexus?

**PROGRAM**
- About the Presenter – career experiences
- WE vs EE – what’s the nexus”?
- Applying energy efficiency in irrigation

**About the Presenter**
- Mixed farm GULNARE, South Australia
- 1948 - 1958
- 2km creek for playground
- Did farm “apprenticeship”
- Innovation permeated farm life
- Made own toys etc
- Pedal car = prime mover
- Challenged status quo throughout life

me
Water Efficiency vs Energy Efficiency

What’s the Nexus?

South Australia

Driest State of the Driest Continent in the World

Murray/Darling catchment

2/3 size of Mississippi/Missouri

South Australia

- 95% area < 10" rainfall
- River Murray lifeline
- 1.5 x area of Texas

Note that USA almost all above 30th Lat Nth.
Australia almost all above 30th Lat Sth.
Therefore, Aust much drier climate.
Water Efficiency vs Energy Efficiency
What’s the Nexus?

- Adelaide, 1.2 million
- Dry year, 90% water pumped from River Murray
- 1000’ lift, 3 or 4 stages
- 4 major pipeline systems
- Approx 130,000 kW (175,000 HP)
- $millions/annum pumping costs
- > 1000 pump tests over 20 yrs

PUMP TESTING with SA Water for 20 years.

PIPELINE FRICTION TESTING with SA Water for 20 years

- From largest (1.8m) to smallest (80mm) pipeline, (Hazen & Williams “C” Values)
- Determine maintenance policy
- Pumping economics
Water Efficiency vs Energy Efficiency
What’s the Nexus?

Pump Design and Build
Hydrotech (Aust) 6 yrs
- 100 pumping systems
- Turf, Horticulture, Ag, Golf
- Design, Build, Commission
- Engineered Product

“There’s a wheel barrow in my Pipeline”
- 10 km of 450NB PVC
- Pumps reduced output
- Pipeline friction test, 2000
- Willunga Basin Water Co

Tallemenco Pty Ltd 2003 to present
- Designed P.S. up to 1,000 l/s
- Bore draw-downs
- Field Evaluations – Irrigation (CIAL Certified)

System Evaluations
- Pumping systems
- Pipeline systems
- Irrigation systems
- Pumping Energy Efficiency audits
Water Efficiency vs Energy Efficiency

What’s the Nexus?

Tallemenco Pty Ltd 2003 to present, (13 yrs)

Pumping System Evaluations

- Pumping Energy Efficiency audits, identified > $500,000 annual elect savings
- More energy efficiency losses in pipes (hydraulics) than in pumps
- Case Study: Pumping energy efficiency audit, Windsor NSW turf farm (for DPI NSW 2014)
  - Efficient Lateral Move
  - 90% losses in pipes
  - 10% losses in pump

Water Efficiency vs Energy Efficiency

How many “MPG” does your pump system do?

\[
\text{$/yr} = \frac{3.15 \times \text{feet head}}{\text{motor } \eta} \times \frac{\text{kWh}}{\text{yr}} \times \frac{\text{Mg/yr}}{\text{pump } \eta} \times \frac{\text{motor } \eta}{\text{drive } \eta}
\]

- Motor efficiency fixed
- Pump efficiency = Worn = off-BEP
- Pump less water a) scheduling b) Soil moisture monitoring
- Tariff – choice of
  - peak
  - Off-peak
  - Week-end

*Refer www.talle.biz/data.html

Elevation
Filter head loss
Main line head loss
Laters head loss
Layflat hose head loss
Emitter head loss
Residual head
### Water Efficiency vs Energy Efficiency: What’s the Nexus?

<table>
<thead>
<tr>
<th>Water Efficiency</th>
<th>V’s</th>
<th>Energy Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Water Requirement</td>
<td></td>
<td>a) Head pumped</td>
</tr>
<tr>
<td>b) Irrigation scheduling</td>
<td></td>
<td>b) Pump effy</td>
</tr>
<tr>
<td>c) Distribution Uniformity</td>
<td></td>
<td>c) Motor effy</td>
</tr>
<tr>
<td>d) Crop water use efficiency</td>
<td></td>
<td>d) Tariff (c/kWh, $/Litre diesel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e) ML pumped</td>
</tr>
</tbody>
</table>

### Notes:
- Water Efficiency
  - a) Water Requirement
  - b) Irrigation scheduling
  - c) Distribution Uniformity
  - d) Crop water use efficiency

- Energy Efficiency
  - a) Head pumped
  - b) Pump effy
  - c) Motor effy
  - d) Tariff (c/kWh, $/Litre diesel)
  - e) ML pumped

**ASIC 2017 NATIONAL CONFERENCE**
**Water Efficiency vs Energy Efficiency**

*What’s the Nexus?*

**Water Required vs Pumped Volume**

Soil Moisture Monitoring

---

**Water Efficiency vs Energy Efficiency**

*What’s the Nexus?*

**Water Efficiency**
- a) Water Requirement
- b) Irrigation scheduling
- c) Distribution Uniformity
- d) Crop water use efficiency

**Energy Efficiency**
- a) Head pumped
- b) Pump effy
- c) Motor effy
- d) Tariff (c/kWh, $/Litre diesel)
- e) ML pumped
**Water Efficiency vs Energy Efficiency**

**What's the Nexus?**

**Irrigation Scheduling vs Pumped Head**

---

**Manual scheduling 1**
- 70 acres landscaping site, 31 stand alone controllers
- Pump system failing on low pressure

Sanctuary Cove Resort, Gold Coast, QLD. 2010

Charts: R Welke

Concentration of scheduling resulted in high peak flow rates, high head losses in pipes

---

**Manual Scheduling 2**
- 28Ha landscaping site, 31 remote controllers
- Rescheduling optimised pump duty required

Rescheduling reduced peak flow by 35%, resulting in less friction losses.

Charts: R Welke
Water Efficiency vs Energy Efficiency

What’s the Nexus?

Water Efficiency vs Energy Efficiency

Water Efficiency

Water Efficiency

Water Efficiency

Water Efficiency

Water Efficiency

Energy Efficiency

Energy Efficiency

Energy Efficiency

Energy Efficiency

a) Water Requirement

b) Irrigation scheduling

c) Distribution Uniformity

d) Crop water use efficiency

a) Head pumped

b) Pump effy

c) Motor effy

d) Tariff (c/kWh, $/Litre diesel)

e) ML pumped

Irrigation Scheduling vs Pump Effy/motor effy

Can affect energy efficiency if irrigation flows are reduced or increased.

$I_00/ML ($370/ac.ft )

Charts: R Welke

Irrigating cabbages
Lindenow, VIC.
Mitchell River
57kW (75hp) diesel
125x100-315
2950rpm pump

2017 NATIONAL CONFERENCE
Water Efficiency vs Energy Efficiency

What’s the Nexus?

Water Efficiency

a) Water Requirement
b) Irrigation scheduling
c) Distribution Uniformity
d) Crop water use efficiency

Energy Efficiency

a) Head pumped
b) Pump effy
c) Motor effy
d) Tariff (c/kWh, $/Litre diesel)
e) ML pumped

Water Efficiency vs Energy Efficiency

Irrigation Scheduling vs Pumped Volume

- Clay soil
- 6 water melon plants
- 8” x 8” soil (paver removed)
- Pulse irrigation (Hunter X-Core)
- 1 x Shrubbler
- Pulse application
- 1 minute x 4 times/day
- 0.7 litre per application
- 360 litres (95 US gall) total
- 9 melons
- 86kg (190 lb) crop

Irrigation Scheduling – pulse irrigation
Water Efficiency vs Energy Efficiency

What’s the Nexus?

Water Efficiency Vs Energy Efficiency

Water Efficiency

- Water Requirement
- Irrigation scheduling
- Distribution Uniformity
- Crop water use efficiency

Energy Efficiency

- Head pumped
- Pump effy
- Motor effy
- Tariff (c/kWh, $/Litre diesel)
- ML pumped

Distribution Uniformity vs Pumped Head

Scheduling Co-efficient

- If CU/DU down
- SC up (Scheduling Coefficient)
- Eg, DU falls from 84% to 73%
- SC rises from 1.3 to 1.6
- That’s 23% more water required

Example:
Toro 640 @ 450 kPa
DU = 84%
SC = 1.3

Example:
Toro 640 @ 350 kPa
DU = 73%
SC = 1.6

Image: Space Pro by Hunter
Water Efficiency vs Energy Efficiency
What’s the Nexus?

Distribution Uniformity vs Pumped Head

Example:
Toro 640
@ 350 kPa
DU = 73%
SC = 1.6

Restoring Pipeline efficiency – known as Pigging or Swabbing

(removing the wheel barrows)

SC Restored
Toro 640 @ 450 kPa
DU = 84%
SC = 1.3

Image: Space Pro by Hunter

Water Efficiency vs Energy Efficiency
What’s the Nexus?

Pipeline friction

Combine “Hazen & Williams” and “Darcy Weisbach Friction factor” Graph of “Pipe Wall Roughness” to “C” value

Reduction of 10% pipe efficiency (C=135) due to only 0.1mm (4 thou) of pipe wall roughness.

This level of roughness cannot be seen with naked eye.
Water Efficiency vs Energy Efficiency
What's the Nexus?

Distribution Uniformity vs Pumped Head

Irrigation Trust, SA
2 x 270hp pumps
675 acres vines, almonds, citrus

- Founded 1968
- 15", 12", 10", 8" Asbestos Cement pipes
- Audited 2015
- H&W C Value new = 140, now = 80 to 110
- Bryozoa - aquatic invertebrate animals (20 thou long)
- Overheads at end of farm < ½ irrigation radius
- DU’s 10 to 20%
- PIR reduced 40% to achieve required distribution efficiency

Long term solution: Replace pipes

River Murray, Mannum SA

Pump Corrosion (Pump efficiency and H-Q loss)
Materials Evaluation
Blue Lake PS, Mt Gambier, SA. 1971
 Austenitic Cast Iron casings (Ni Resist)
  - Resistance to sea water corrosion
  - used on ships propellers
  - Ni 20.0, Cr 2.5, C 3.0, Si 2.0, Mn 1.0 typ.

- Tested after 1 year for efficiency
- Down 10%
- Casings badly corroded
- Materials specific to water quality

Blue Lake PS
Mt Gambier, SA.
Primary Lift Pumps

Photos: ABC.net.au
Impeller Coatings Evaluation

Mannum Adelaide No. 1 Pumping Station. 1975

- Cast Iron casings, Bronze impellers
- Pump tested, efficiency recorded
- Impeller coated - DULUX gloss enamel
- Pump retested – 4% efficiency gain
- Pump tested 1 yr, lost η% and paint

Conclusions
- Smooth coating > increased η%
- Conventional coatings not satisfactory
- Search for hi-tech coatings
- Adopted “Belzona”, 25% metallic content

Impeller Coatings (pump corrosion)

Eg, Irrigation and Water Supply Pumps, Riverland Region, SA, 1980’s

- Eliminate Blulon (asbestos) gland packing
- Move to mechanical seals
- Rotating elements balanced
- Pump casings coated (Belzona)
- Impellers coated (Belzona – 25% metal)

Pumps tested less regularly
- Sustained efficiency
- High reliability
Water Efficiency vs Energy Efficiency
What’s the Nexus?

Distribution Uniformity vs Pumped Head

As designed
- 25 l/s flow
- 10m head loss

Modified
- Add 3 l/s end of pipe
- 8m extra head loss

Optimized pipe system
- Extend 6" by 150m
- Shortened 4" by 50m
- Shortened 3" by 100m
- Gained 3.4m
- Saved $13,400 / 15 yrs

Water Efficiency vs Energy Efficiency
What’s the Nexus?

Water Efficiency
- a) Water Requirement
- b) Irrigation scheduling
- c) Distribution Uniformity
- d) Crop water use efficiency

Energy Efficiency
- a) Head pumped
- b) Pump effy
- c) Motor effy
- d) Tariff (c/kWh, $/Litre diesel)
- e) ML pumped
Water Efficiency vs Energy Efficiency

What's the Nexus?

Distribution Uniformity vs Tariff

Irrigation Trust, SA
2 x 270hp pumps
675 acres vines, almonds, citrus

- H&W C Value new = 140, now = 80 to 110
- Overheads at end of farm < ½ irrigation radius
- DU's 10 to 20%
- PIR reduced 40% to achieve required distribution uniformity
- Overflow irrigation into higher day time tariff

River Murray, Mannum SA

Water Efficiency vs Energy Efficiency

What's the Nexus?

Water Efficiency

a) Water Requirement
b) Irrigation scheduling
c) Distribution Uniformity
d) Crop water use efficiency

d) Water

Energy Efficiency

a) Head pumped
b) Pump effy
c) Motor effy
d) Tariff (¢/kWh, $/Litre diesel)
e) ML pumped

Water Efficiency vs Energy Efficiency

What's the Nexus?

River Murray, Mannum SA
Water Efficiency vs Energy Efficiency
What’s the Nexus?

Crop Yield vs Pumped Volume (+ Scheduling + Tariff)
Example: Sugar cane crop, Nth QLD

BEFORE
- PIR 11mm/day
- CP/LM or Gig Gun (SC 1.2/1.6)
- 11 ML/ha (8.9 ac.ft)
- Evenly across crop life
- 95 t/ha (38t/ac) ave
- $2600/ha ($1040/ac) ave

AFTER
- PIR 14mm/day
- Sub Surface Drip (+30% CAPEX, -30% pumping head, -30% SC)
- 7 ML/ha (5.7 ac.ft)
- (50% less kWh pumping)
- Growth based irrigation (flowering/fruiting)
- 137 t/ha (55t/ac) ave, 238t/ha max
- $4500/ha ($1800/ac) ave

Example per Jim Phillips, ASIC’s newest Aussie member – ph +61 435 187 486

Water Efficiency vs Energy Efficiency
What’s the Nexus?

Water Efficiency
a) Water Requirement
b) Irrigation scheduling
c) Distribution Uniformity
d) Crop water use efficiency

V’s

Energy Efficiency
a) Head pumped
b) Pump effy
c) Motor effy
d) Tariff (c/kWh, $/litre diesel)
e) ML pumped
Example: Sugar cane crop, Nth QLD

Irrigation during day time
“crop water uptake”
= higher tariff costs

**BEFORE**
- PIR 11mm/day
- CP/LM or Gig Gun (SC 1.2/1.6)
- 11 ML/Ha (8.9 ac.ft)
- Evenly across crop life
- 95 t/Ha (38t/ac) ave
- $2600/Ha ($1040/ac) ave

**AFTER**
- PIR 14mm/day
- Sub Surface Drip (+30% CAPEX, -30% pumping head, -30% SC)
- 7 ML/Ha (5.7 ac.ft)
- (50% less kWh pumping)
- Growth based irrigation (flowering/fruiting)
- 137 t/Ha (55t/ac) ave, 238t/Ha max
- $4500/Ha ($1800/ac)

Example per Jim Phillips, ASIC’s newest Aussie member – ph +61 435 187 486

---

**Water Efficiency vs Energy Efficiency**

**What’s the Nexus?**

**Water Efficiency vs Energy Efficiency**

**Summary**

a) Water Requirement
b) Irrigation Scheduling
c) Distribution
  Uniformity
d) Crop water use efficiency

<table>
<thead>
<tr>
<th>a) Head pumped</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Pump effy</td>
</tr>
<tr>
<td>c) Motor effy</td>
</tr>
<tr>
<td>d) Tariff (c/kWh, $/Litre diesel)</td>
</tr>
<tr>
<td>e) ML pumped</td>
</tr>
</tbody>
</table>
Water Efficiency vs Energy Efficiency

What’s the Nexus?

Water Efficiency vs Energy Efficiency

- How to assess poor energy efficiency?
- How to design best practice energy efficiency irrigation systems
- Get more “MPG” from your pumping system!

IPEEAT
Irrigation Pumping Energy Efficiency Assessment Tool

An APP based program to:
- assess the energy efficiency of an irrigation pumping system (electric)
- compare it to a similar irrigation system designed to best practice
- determine the commercial viability of pursuing further energy auditing
- Suitable for rising mains up to 1km (1,000 yds) long
- Available on Google Play Store
Water Efficiency vs Energy Efficiency
What’s the Nexus?

IPEEAT: Irrigation Pumping Energy Efficiency Assessment Tool
Divides Irrigation into 8 distinct hydraulic models:
- CP/LM, Boom,
- Gun
- Knocker, Rotor,
- Drip, spray
- Flood
- Pipe & Riser
- Transfer
- Marine

Suitesd for rising main up to 1000 yards long

IPEEAT assesses overall pumping energy efficiency considering both pumping efficiency and hydraulic efficiency by comparing existing on farm performance with a similar type irrigation system built to best practice design in its class.

IPEEATproLP: Irrigation Pumping Energy Efficiency Assessment Tool Professional (Long Pipe)

Considers:
- Pumping system
- Pipeline system (any length)
- Does not include emitters

IPEEATpro assesses pipeline energy efficiency by comparing existing on farm pipeline performance with a similar type pipeline system built to best practice design in its class over 25yr life cycle.

Under development
Release late 2017
Water Efficiency vs Energy Efficiency

What's the Nexus?

Irrigation System Design approach - typical

Irrigation design

Pumping/pipeline design – all too often

ASIC
2017 NATIONAL CONFERENCE
Irrigation System Design approach - Tallemenco

Water Efficiency vs Energy Efficiency
What’s the Nexus?

Irrigation design

Pumping/pipeline design

TALLEMENCO – Online Training

“Advanced Pumping & Hydraulics”
(Teaches how to apply pumping energy efficiency principles to existing irrigation systems)
6 sessions of 2 hrs per session over 6 weeks
Next course commences May 30th 2017
Cost $650 AUD

“Advanced Pumping System Design”
(Teaches how to design pumping energy efficiency principles into new irrigation systems)
6 sessions of 2 hrs per session over 6 weeks
Next course commences May 30th 2017
Cost $650 AUD

Both courses endorsed by Irrigation Australia Limited (IAL) for Professional Development – 2 PD points each

Courses run through River Murray Training, Berri South Australia. Ph Barb on +61 417 824 442.
Water Efficiency vs Energy Efficiency

What’s the Nexus?

Water Efficiency V’s Energy Efficiency

Proudly presented by

Rob Welke, Tallemenco

Thank you