Tim Fredericks

ASIC 2016 REGIONAL CONFERENCES

Southeast, Southwest, Northeast, & California

American Society of Irrigation Consultants

ASIC 2016 – Northeast Regional Conference
Pay Me now or Pay Me Later

Pay me now or Pay me later

Challenges in Owner understanding how to ascertain true nature of costs at the beginning of the project generally lead to dissatisfaction at the end of the project in either the Owner, Vender, and/or the Manufacturer

Irrigation Consultant is not listed as being dissatisfied

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Owner Dissatisfaction

- Irrigation system not reliable and/or under-performing
- The effects of “Value-Engineering”
- Additional restoration costs
- Earlier than anticipated costs due to failures in hardware
- Poor relationship with Contractor/Distributor and/or Manufacturer

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Contractor Dissatisfaction

- Did not make anticipated profit on job
- Poor reference upon completion
- Damaged relationship with Owner, Consultant and/or Vendor/Manufacturer
- Longer time to completion causing loss of future revenue

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Vender/Manufacturer Dissatisfaction

- Did not make anticipated profit on job
- Poor reference upon completion
- Damaged relationship with Owner and Consultant
- “Soft” costs of having to ensure Owner is “happy” with the system once Contractor is gone – feel the effects of budgets for long after the project is completed

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Budgeting Landmines effecting Actual Costs/Results

- Owner does not provide clear criterion to Consultant
- Owner cannot answer expected longevity question
- Ignoring the premise that Contractors/Suppliers need to make a reasonable profit
- Contingency is for once the digging starts
- “Value Engineering” is not a direct synonym for “reducing-costs”

In 2015, an irrigation upgrade is best thought of as an installing reliable cost-effective infrastructure that delivers water at constant pressure

Establishing an understanding that there is balance between the system cost and longevity of the hardware

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General Components of Irrigation System

- Central Irrigation Computer
- On-site control (Satellites/Decoders)
- Piping (Mainline and Laterals)
- Valves (Isolation and Drain)
- Wire (High Voltage, Communication, Field Control)
- Fittings and Restraints
- Sprinklers and Electric Valves
- Pumpstation, Wells, and Transfer Pumps
- Hard structure – Pumphouse, Intake, and Wet Well
- Weather Station and Sensors
- As Built/Baseplan Drawing

Components of a System
Possible Life-spans

Expected # of Years	Item
2	Solar radiation and RH on WS
3	Central Support and Warranty Service
3-5*	**Irrigation Central Computer (OEM)**
5*	**comprehensive Base Plan/As-Built update**
5*	handheld radios
10	central irrigation software package
10-15*	pump turbine removal and over-hall
12-20*	possible nozzle replacement
15-20*	rotor gear drive replacement
20-25	Satellite update and or replacement
30-35*	sprinkler body replacement
25-40*	**Lateral pipe (3" and smaller) replacement**
25-40*	pump station replacement

What is considered excessive or “not in the our budget?”

50 year old fitting being “re-installed”!

Factors/Choices Effecting Cost vs. Reliability
Thrusting and Restraints Choices

Factors/Choices Effecting Cost and Life Expectancy

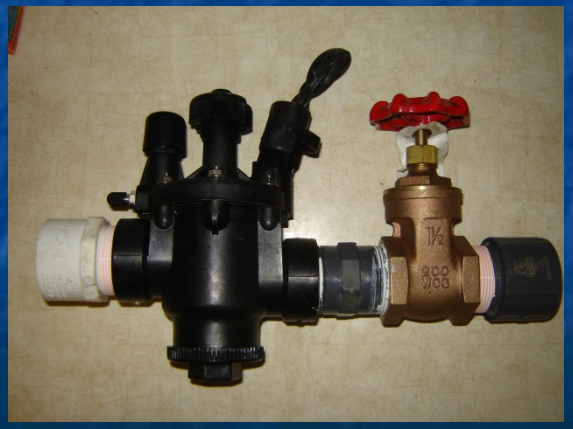
The Wide World of Valves

- Choose correct valve type (C515, C509, Resilient wedge, brass gate, swivel)
- Know the different type of valve connections (MJ, Push-on, PE HDPE)
- Use correct restraints with valves
- Make sure valves are supported
- Ensure valve is accessible
- Understand your water conditions
- Plan for phasing (type and location)
- Understand that with valves you get what you pay for

Factors/Choices Effecting Costs vs. Reliability
Examples of Valving Choices

Factors/Choices Effecting Cost vs. Reliability
Examples of Valving Choices

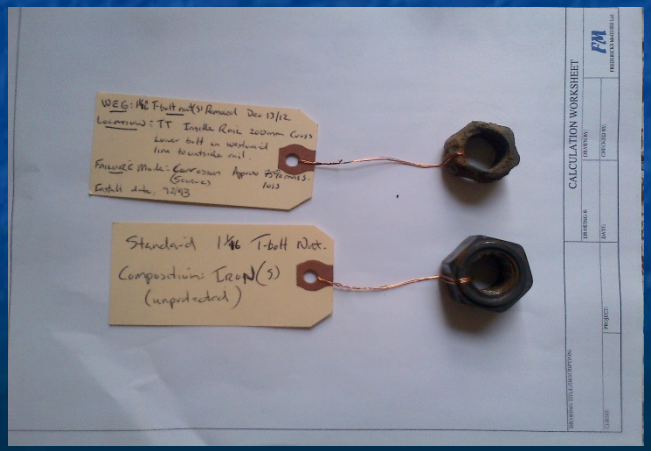
Factors/Choices Effecting Cost vs. Reliability
Examples of Valving Choices



Future of Mainline Valving Choices

While lighter, better corrosion protection, easier to install but do you get what you pay for?

Longevity vs Budget
Examples of Costly Decisions



Budgeting Strategy "Don't"
Your only costing Yourself!

- Do not tell Contractor, Distributor, and/or any Vendor any budget expectations
- Do not forget who the Owner is purchasing the system from and its implication on budget
- Do not re-prioritize budget based "Other" influences
- Do not use neighbouring Club's project costs act as benchmark of a valid quote or bid
- Do not "budget" based on playing multiple Contractors against each other at the same time

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Actions that can ensure costs are accurately reflected

- **Get price to install system at agreed upon criterion and then set budget**
- **Have clear understanding of how cost reductions effect longevity and performance**
- **Banish concept of “value engineering” from discussion**
- **Understand what a reasonable profit represent to all parties (see example next slide!)**

Material Description	Quantity	Unit	Manufacturer	Vender/Manufacturer Part Number	Unit Pricing to Supply Material	Total Unit Supply and Install Price (Will be referred to for addition purposes only)	Total Unit Supply and Install Price (Will be used for deviation purposes)
Wire							
Paige 18 AWG, 2-pair shielded wire *or approved equal* (weather station)	max 205M	linear metre	Paige				
P E 14/2 AWG Special Irrigation control wire (red) (weather station)	max 205M	linear metre	Paige				
P E 14 AWG control wire *or approved equal* (field wire)		linear metre					
P E 12 AWG Common wire *or approved equal* (white only)		linear metre					
RWU-90 XLPE 14 AWG Tracer wire - *or approved equal* (yellow only)		linear metre					
NMWU 12/2 wire - black only		linear metre					
NMWU 10/2 wire - black only		linear metre					
NMWU 8/3 wire - black only		linear metre					
NMWU 6/2 wire - black only		linear metre					
NMWU 4/2 wire - black only		linear metre					
NMWU 2/2 wire - black only		linear metre					
1.0 wire TWU - all three conductors		linear metre					
Valves							
AVK 300mm Resilant Wedge Gate Valve NRS (AWWA C-509) MJxMJ c/w restrainrs		each	Mueller				
AVK 250mm Resilant Wedge Gate Valve NRS (AWWA C-509) MJxMJ c/w restrainrs		each	Mueller				
AVK 200mm Resilant Wedge Gate Valve NRS (AWWA C-509) MJxMJ c/w restrainrs		each	Mueller				
AVK 150mm Resilant Wedge Gate Valve NRS (AWWA C-509) MJxMJ c/w restrainrs		each	Mueller				
AVK 100mm Resilant Wedge Gate Valve NRS (AWWA C-509) MJxMJ c/w restrainrs		each	Mueller				
AVK 75mm Resilant Wedge Gate Valve NRS (AWWA C-509) MJxMJ c/w restrainrs		each	Mueller				
AVK 100mm Resilant Wedge Gate Valve (AWWA C-509) push-on or A.E.		each	Mueller				
AVK 75mm Resilant Wedge Gate Valve (AWWA C-509) push-on or A.E.		each	Mueller				
AVK 50mm Resilant Wedge Gate Valve (AWWA C-509) push-on or A.E.		each	Mueller				
Mueller 50mm Resilant Wedge Gate Valve (AWWA C-509) thd x thd		each	Mueller				
25mm (1") Lasco "Trve Union" Slow Close Plastic valve		each	Lasco/Colonial				
Ductile Iron Fittings and Restraints							
Sigma 350 DMS (Short Sleeve) or A.E.		ea	Sigma				
5.6 threaded rod (2.1M)		unit price	mue				
5.6 Mueller bolt or A.E.		unit price	Mueller				
Hanna 3"x3"x3" tee D.I.		ea	Hanna				
Hanna 3"x3"x2.5" tee D.I.		ea	Hanna				
Hanna 3"x3"x2" tee D.I.		ea	Hanna				
Hanna 3"x3" 90° elbow D.I.		ea	Hanna				
Hanna 4"x4"x4" tee D.I.		ea	Hanna				
Hanna 4"x4"x3" tee D.I.		ea	Hanna				
Hanna 4"x4"x2.5" tee D.I.		ea	Hanna				
Hanna 4"x4"x2" tee D.I.		ea	Hanna				
Hanna 3"x3" 90° elbow D.I.		ea	Hanna				
Hanna 3"x3" 45° elbow D.I.		ea	Hanna				
Hanna 3"x3" 22.5° elbow D.I.		ea	Hanna				
Hanna 4"x4" 90° elbow D.I.		ea	Hanna				
Hanna 4"x4" 45° elbow D.I.		ea	Hanna				
Hanna 4"x4" 22.5° elbow D.I.		ea	Hanna				
Hanna 4"x1.5" Tap Tee D.I (GxGxASME)		ea	Hanna				
Hanna 4"x2" Tap Tee D.I. (GxGxFIPT)		ea	Hanna				
Hanna 4"x1" Tap Tee D.I. (GxGxFIPT)		ea	Hanna				
Hanna 2" valve-to-pipe restraint		ea	Hanna				
Hanna 2.5" valve-to-fitting restraint		ea	Hanna				
Hanna 3" valve-to-fitting restraint		ea	Hanna				
Hanna 4" valve-to-fitting restraint		ea	Hanna				
Hanna 2" fitting-to-valve-pipe restraint		ea	Hanna				
Hanna 2.5" fitting-to-valve-pipe restraint		ea	Hanna				
Hanna 3" fitting-to-valve-pipe restraint		ea	Hanna				
Hanna 4" fitting-to-valve-pipe restraint		ea	Hanna				
Hanna 4" pipe-pipe restraint *or approved equal*		ea	Hanna				
Hanna 4" Knuckle restraint		ea	Hanna				
Hanna 3" Knuckle restraint		ea	Hanna				
Hanna 2.5" Knuckle restraint		ea	Hanna				
Hanna 2" Knuckle restraint		ea	Hanna				
Miscellaneous							
50mm (2") A.R.I Combination Air Valve Assembly c/w valve and strainer		ea	A.R.I				
Drip Irrigation Assembly Complete		ea					
1" Quick Coupler		ea					
12" Standard Rectangular Valve Box		ea					
Jumbo Rectangular Valve Box		ea					
18" Round Valve Box		ea					
6" Round Valve Box		ea					

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Questions?

Brian Vinchesi

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Pay Me Now or Pay Me .....Later?

or Forever?

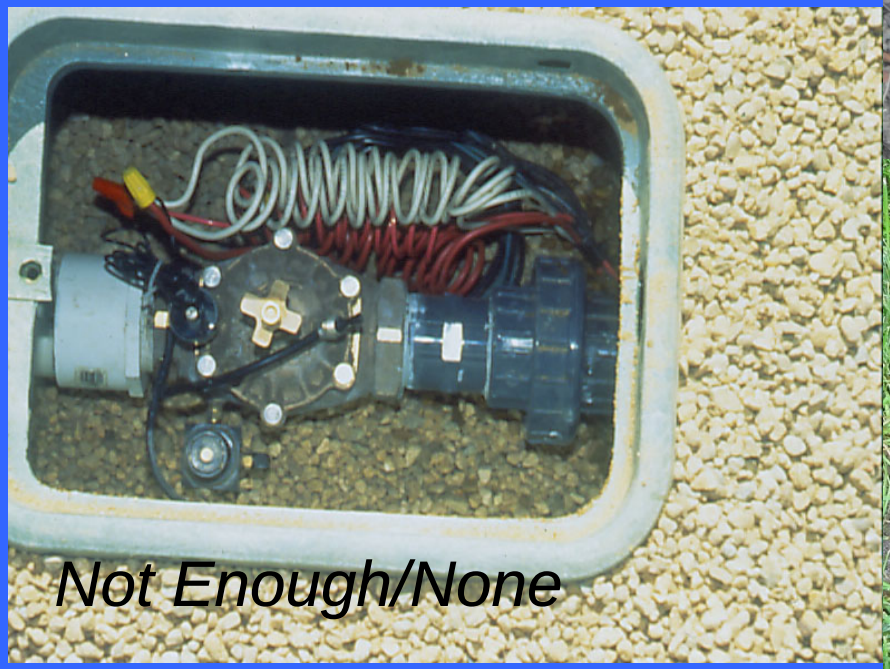
Brian E. Vinchesi, FASIC, EIT, LEED-AP, CID, CIC, CLIA, CGIA, CWM-L

ADDITIONAL COSTS

- *Consultants tend to use better products that cost more money that many contractors and cost estimators miss.*
- *For example:*
  - *Pressure Regulation*
  - *Flow Control*
  - *Isolation*
    - *Mainline, Lateral , Valve*
  - *Quick Couplers*
  - *Single Strand Wire*

WIRE CONNECTORS

- *Lots of choices but are the choices all the same?*
- *UL 486D Listed*



Not Enough/None

Too Many

Well……..

VALVE BOXES

- *Residential Grade*
- *Commercial Grade*
- *Plastic or Concrete*
- *Detection*
- *Bolt Down Covers*
- *Specialty Boxes*
- *H20 Loading*

CONTROLLERS

- *Conventional*
  - *Features*
- *Smart*
  - *Climate or Soil Moisture Based*
- *Costs*
- *Surge Protection Grounding*

SOIL MOISTURE SENSORS

- *Safety*
  - *Off Switch*
  - *Adjustable Moisture Level*
- *Monitor and Tracking*
- *Water Management*
- *LEED*

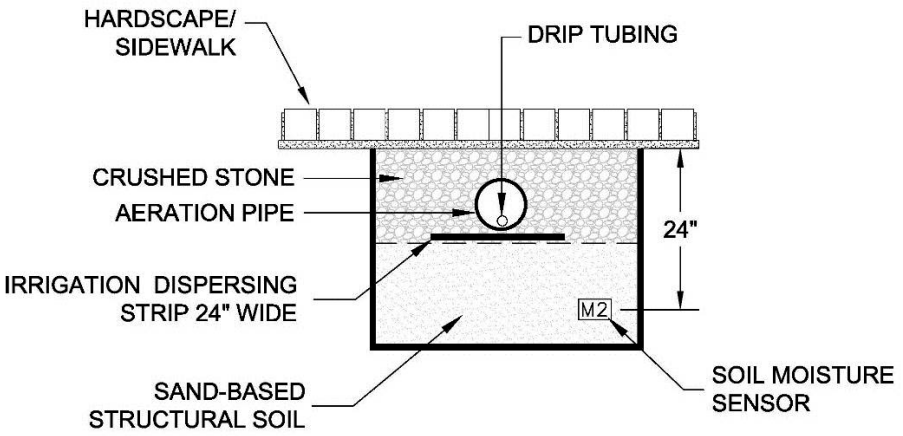
URBAN TREES

- *Typically tree irrigation has been done with spray sprinklers or bubblers which use large amounts of water.*
- *Drip rings have also been used.*
- *Newer technologies include drip stakes which do a better job of applying water directly to the root ball at lower application rates.*

DRIP IRRIGATION UNDER PAVEMENT

- Drip tubing in aeration pipe
- Stakes zoned separately from future root propagation area
- Additional benefit of adding air and fertilizer
- No run-off
- Little impact on existing roots
- Rarely costed correctly

Aeration Pipe with Irrigation



LEED

- *Can add considerable cost to the system for :*
  - *Better products*
  - *Smart Technology*
  - *Higher Installation Costs*
  - *Alternative water Supplies*
  - *Logic*

ODD SYSTEMS

Government

Synthetic

LARGE SYSTEMS

- *Larger systems require more expensive components:*
  - *Material, Size, Life Expectancy, Installation*
- *Installation Expertise*

ALTERNATIVE WATER SOURCES

- *Various sources:*
  - *Rainwater*
  - *Storm Water*
  - *Waste Treatment*
- *Need to minimize contaminants*
- *Treatment is Expensive!!*
- *A place that everyone likes to VE but not a place you can/should do it*

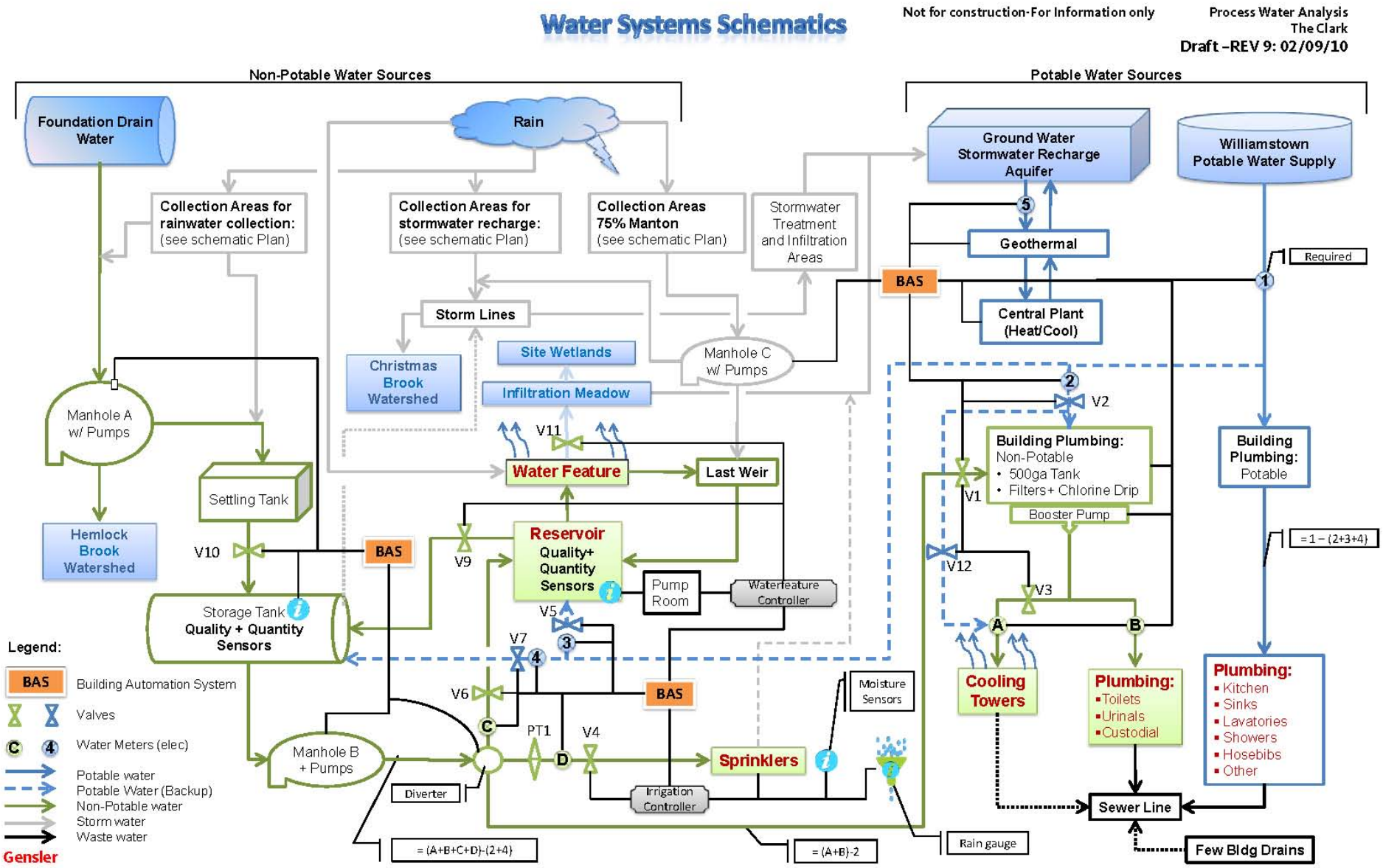
TANKING

- *A place to make lots errors*
  - *Sizing*
  - *Material*
  - *Installation*
- *Logic*

TANKING

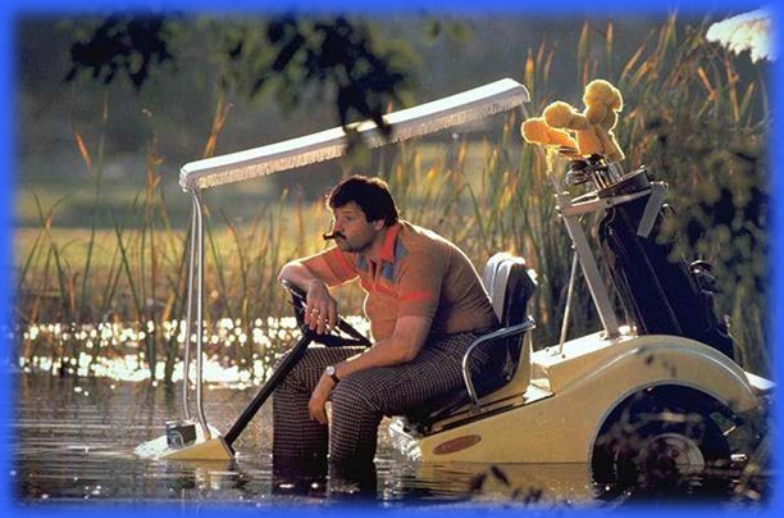
COST!

COMPLEXITY


Water Systems Schematics
Not for construction-For Information only
Process Water Analysis
The Clark
Draft –REV 9: 02/09/10
Non-Potable Water Sources
Potable Water Sources
Foundation Drain Water
Rain
Collection Areas for rainwater collection: (see schematic Plan)
Collection Areas for stormwater recharge: (see schematic Plan)
Collection Areas 75% Manton (see schematic Plan)
Stormwater Treatment and Infiltration Areas
Ground Water Stormwater Recharge Aquifer
Williamstown Potable Water Supply
Geothermal
Central Plant (Heat/Cool)
BAS
Required
Storm Lines
Site Wetlands
Infiltration Meadow
Christmas Brook Watershed
Manhole C w/ Pumps
Manhole A w/ Pumps
Settling Tank
Hemlock Brook Watershed
V10
V11
Water Feature
Last Weir
V9
Reservoir Quality+ Quantity Sensors
Pump Room
Waterfeature Controller
Storage Tank Quality + Quantity Sensors
V5
V7
V6
PT1
V4
Sprinklers
Moisture Sensors
Irrigation Controller
Diverter
Manhole B + Pumps
Rain gauge
= (A+B+C+D)-(2+4)
= (A+B)-2
V2
Building Plumbing: Non-Potable
• 500ga Tank
• Filters+ Chlorine Drip
Booster Pump
V1
V12
V3
Building Plumbing: Potable
= 1 – (2+3+4)
Cooling Towers
Plumbing:
▪ Toilets
▪ Urinals
▪ Custodial
Plumbing:
▪ Kitchen
▪ Sinks
▪ Lavatories
▪ Showers
▪ Hosebibs
▪ Other
Sewer Line
Few Bldg Drains
Legend:
BAS Building Automation System
Valves
Water Meters (elec)
Potable water
Potable Water (Backup)
Non-Potable water
Storm water
Waste water
Gensler

BUDGETING

- *Commercial irrigation system budgeting is usually done in a vacuum.*
- *The cost estimator or General Contractor gives it a number based on square footage that is usually way too high or way too low.*
- *Then when they get the pricing they wonder why the Contractor is so high.*



BUDGETING

- *A typical Contractor's traditional practice is to use the cost of materials times a multiplier.*
- *Higher end Contractors may look at actual material, labor, equipment and overhead costs.*
- *Professional cost estimators have a tendency to use square footage rules but many don't have a clue.*

COSTS

- *Use square foot pricing when no design*
- *Per Square Foot*
  - *Conventional* *$1.50*
  - *More Intense* *$2.,50*
  - *Under Paver* *$3.00*
  - *Green Roof* *$3.50*
- *Use material take offs with multiplier when have design*
- *Use sprinkler multiplier for golf plus all other costs*

VALUE ENGINEERING

- *UGH!*
- *Consultants hate it!*
- *Manufacturers hate it!*
- *Many Contractors embrace it or promote it.*
- *Owners' don't understand it!*
  - *"Include Nibco T-113 gate valves with Matco or equiv. (Sizes 1, 1 1/2, 2 only), after above reduction in valves."*

"I'm sending you this note to hopefully explain why the butt fused pipe that is spec'd for the irrigation mainline is unnecessary……."

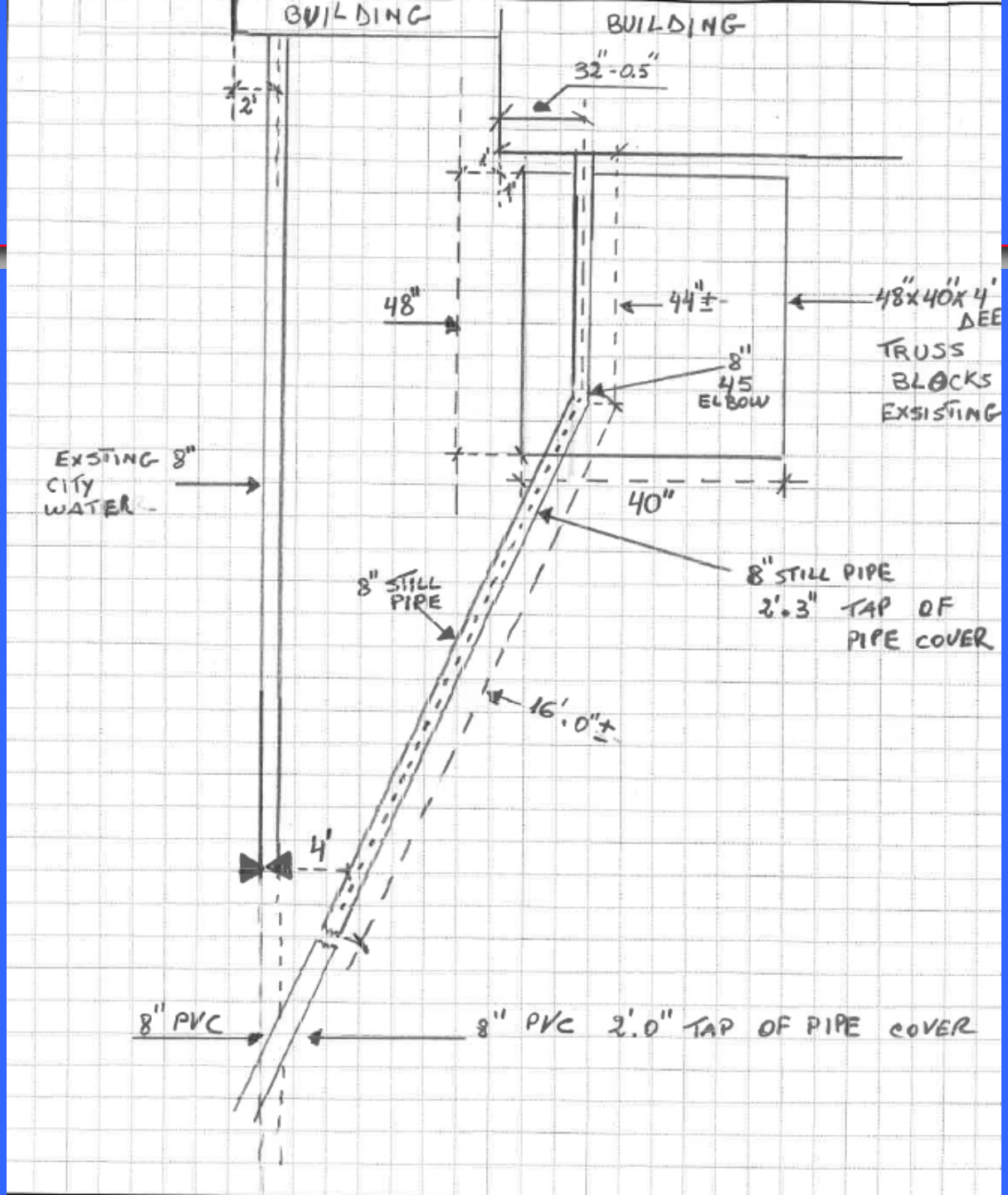
I have been in the irrigation industry for 18 years installing systems from a 20 head residential to a 1000 head plus commercial system drawn and spec'd by professional design firms and have never been asked to install butt fused pipe. The butt fused pipe option is rarely, if ever required for irrigation, at least in New England. So, the equipment and expertise is not necessary to be a successful irrigation contractor in New England.

INSTALLER QUALIFICATIONS

- *The installer selected plays a large role in the long term costs of the irrigation system.*
- *Many times specification installer qualifications are not enforced.*
- *This is especially an issue with public work.*
- *Submittals are a “sign” of what is to come.*
- *Hard to assign a $ figure to poor installation.*

OTHER COSTS

- *Water*
  - *How much is saved or wasted?*
- *Energy*
  - *How much energy is being used?*
  - *Alternative water sources are energy inefficient in most cases.*
- *Maintenance*
  - *How much additional maintenance is required based on the materials selected and the design?*


BUILDING
BUILDING
32"-0.5"
2'
1'
48"
44"±
48"x40"x4'
DEE
TRUSS
BLOCKS
EXSISTING
8"
45
ELBOW
EXSTING 8"
CITY
WATER
40"
8" STILL PIPE
8" STILL PIPE
2'.3" TAP OF
PIPE COVER
16'.0"±
4'
8" PVC
8" PVC 2'.0" TAP OF PIPE COVER


STOP

QUESTIONS

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www.irrigationconsulting.com

Jeff Bowman & Bob Dobson

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Who's on First?

Delineation of Trades

Jeff Bowman/Bob Dobson

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Design/Coordination/Construction Gap

- The Responsibility and Limit of Work of the Irrigation Consultant and Irrigation Contractor
- MEP Role
- Plumbers and Electricians Role
- Architect and GC Role
- Who has jurisdiction?

Examples

- Commercial Buildings
- Green Roofs
- Green Walls/Interior Landscape
- Perimeter Landscape
- Pumping Systems
- Reclaimed Water

Commercial Buildings

Green Roofs

Green Walls

Other??

Perimeter Landscape

Irrigation Pump Systems

Generally Speaking

- Plumbing Work Stops 5-Feet From Exterior Wall
  - Extend beyond the perimeter drain
  - Perceived to be IAPMO jurisdiction from this point inward (into the building)
- All interior plumbing installed by plumber
  - Design by plumbing engineer with close consultation with irrigation consultant


IRRIGATION WATER


1335
VAN NESS

Interior Pumps

- Interior irrigation pumps installed by plumbers and mechanical contractors (Procurement by Irrigation Contractor)
  - Design/specification by irrigation consultant with close consultation with plumbing and electrical engineers
  - MEP does not have the experience in living landscapes and soils

Rain Harvesting/Reclaimed Water

- Interior Storage Tank
- Roof Runoff
- HVAC Condensate
- 2018 Green Construction Code
  - No potable water for vegetative roofs (Model Code)

Rain Harvesting/Reclaimed Water

Rain Harvesting/Reclaimed Water

- Interior storage tank design recommended to be designed by the MEP Engineers
- Tank sizing by irrigation consultant based on landscape water demand and supply inputs provided by MEP Engineers.

- Best to have the MEP engineers take responsibility for backflow prevention and any primary water meters.
- Secondary irrigation/sub-meters specified by the irrigation consultant
  - Sub-meters often communicate directly with irrigation controllers and/or irrigation pump controls
  - LEED Requirements

Electrical

- Generally speaking (Massachusetts), all interior wiring conduits/routing by the electrical engineers/designers with input from the irrigation consultant
- Low voltage wiring within the building (in conduit) specified by irrigation consultant
- Plenum rated wire in some instances
- All interior 120-volt and above wiring by electrical engineers/designers

Electrical

- Irrigation consultant must know all electrical needs of his/her equipment for proper coordination with electrical designers:
  - Pump system power (phase, voltage and current demand)
  - Irrigation controller power
  - Irrigation controller low voltage wiring (two wire or individual station wiring) and the destination of all low voltage branch circuits
  - Ethernet
    - BAS/BMIS
  - Antennas
  - Rain/Weather Sensors
- One line diagram is recommended

Exceptions


PLUMBERS & PIPEFITTERS
LOCAL 9
NEW JERSEY
HVAC/R TECHNICIANS

Trade delineations vary by

- State
- Local jurisdiction
- Client

Consultant's responsibility

- Who is to do what?
- Labor source
  - Open shop
  - Prevailing wage
  - Union
- Trades involved
- Permits required

ASIC

Consultant's responsibility

Contractor's Responsibilities in Preparing Bid

– Read the specifications

Contractor's Responsibilities in Preparing Bid

- Read the specifications
- Understanding labor source, what trades are involved and their requirements
- Notify consultant of any problems, errors or unreal expectations

Irrigation Contractor can be:

- Prime Contractor - General Contractor
- 1st Tier Sub to General Contractor
- 2nd Tier Sub to Site Contractor or Plumber
- 3rd Tier Sub to Landscaper Contractor

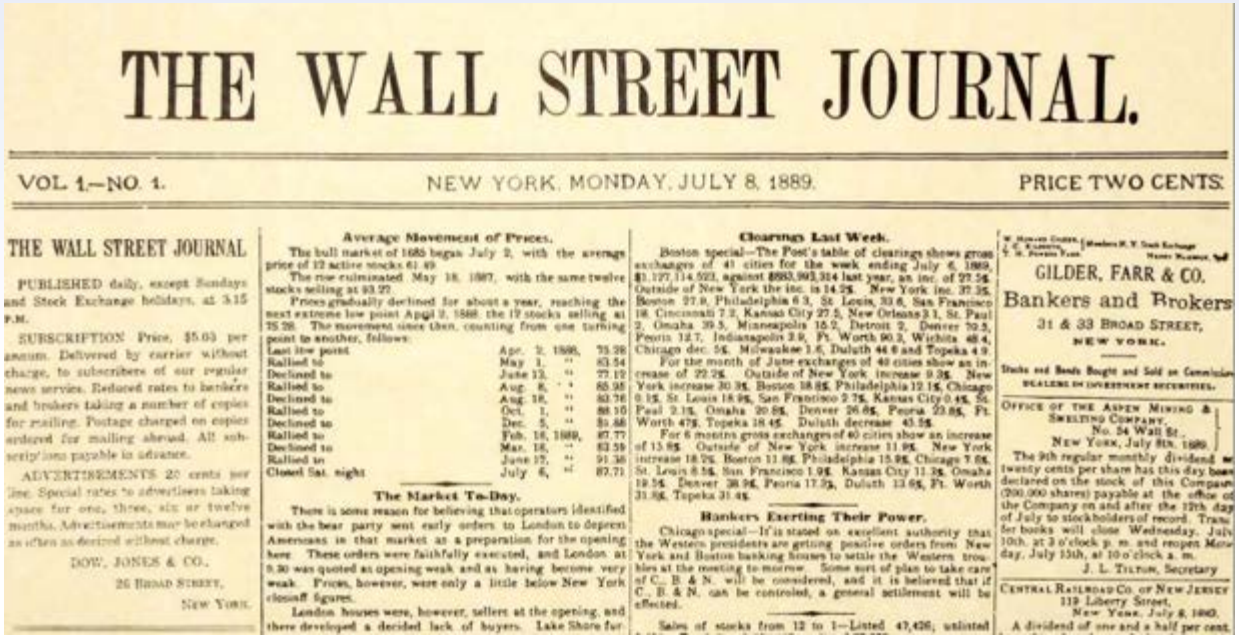
Contractor Responsibilities

Potential Trades Involved

- Surveyors
- Teamsters
- Operating Engineers
- Iron Workers
- Plumbers
- Electricians
- Laborers
- Masons
- Elevator Operators
- Others?

Potential Trades Involved

Potential Trades Involved



THE WALL STREET JOURNAL.

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THE WALL STREET JOURNAL

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DOW, JONES & CO.,
26 BROAD STREET,
NEW YORK.

Average Movement of Prices.

The bull market of 1885 began July 2, with the average price of 12 active stocks 61.69

The rise culminated May 18, 1887, with the same twelve stocks selling at 93.27.

Prices gradually declined for about a year, reaching the next extreme low point April 2, 1888, the 12 stocks selling at 75.28. The movement since then, counting from one turning point to another, follows:

Last low point	Apr. 2, 1888,	75.28
Rallied to	May 1, "	83.54
Declined to	June 13, "	77.19
Rallied to	Aug. 8, "	85.95
Declined to	Aug. 18, "	83.76
Rallied to	Oct. 1, "	88.10
Declined to	Dec. 5, "	81.66
Rallied to	Feb. 16, 1889,	87.77
Declined to	Mar. 18, "	83.59
Rallied to	June 17, "	91.36
Closed Sat. night	July 6, "	87.71

The Market To-Day.

There is some reason for believing that operators identified with the bear party sent early orders to London to depress Americans in that market as a preparation for the opening here. These orders were faithfully executed, and London at 9.30 was quoted as opening weak and as having become very weak. Prices, however, were only a little below New York closing figures.

London houses were, however, sellers at the opening, and there developed a decided lack of buyers. Lake Shore for-

Clearings Last Week.

Boston special—The Post's table of clearings shows gross exchanges of 40 cities for the week ending July 6, 1889, $1,127,114,523, against $883,993,314 last year, an inc. of 27.5%. Outside of New York the inc. is 14.2%. New York inc. 37.3%. Boston 27.0, Philadelphia 6.3, St. Louis, 33.6, San Francisco 18, Cincinnati 7.2, Kansas City 27.5, New Orleans 3.1, St. Paul 2, Omaha 39.5, Minneapolis 15.2, Detroit 2, Denver 70.5, Peoria 12.7, Indianapolis 2.6, Ft. Worth 90.3, Wichita 48.4, Chicago dec. 5%. Milwaukee 1.6, Duluth 44.6 and Topeka 4.9.

For the month of June exchanges of 40 cities show an increase of 22.2%. Outside of New York increase 9.3%. New York increase 30.3%, Boston 18.8%, Philadelphia 12.1%, Chicago 6.1%, St. Louis 18.9%, San Francisco 2.7%, Kansas City 0.4%, St. Paul 2.1%, Omaha 20.8%, Denver 26.6%, Peoria 23.8%, Ft. Worth 47%, Topeka 18.4%. Duluth decrease 43.3%.

For 6 months gross exchanges of 40 cities show an increase of 13.8%. Outside of New York increase 11.9%. New York increase 18.2%, Boston 11.8%, Philadelphia 15.9%, Chicago 7.6%, St. Louis 8.5%, San Francisco 1.9%, Kansas City 11.3%, Omaha 19.5%, Denver 36.9%, Peoria 17.3%, Duluth 13.6%, Ft. Worth 31.8%, Topeka 31.4%.

Bankers Exerting Their Power.

Chicago special—It is stated on excellent authority that the Western presidents are getting positive orders from New York and Boston banking houses to settle the Western troubles at the meeting to-morrow. Some sort of plan to take care of C., B. & N. will be considered, and it is believed that if C., B. & N. can be controled, a general settlement will be effected.

Sales of stocks from 12 to 1—Listed 47,426; unlisted

OFFICE OF THE ASPEN MINING & SMELTING COMPANY,
No. 34 Wall St.,
NEW YORK, July 8th, 1889.

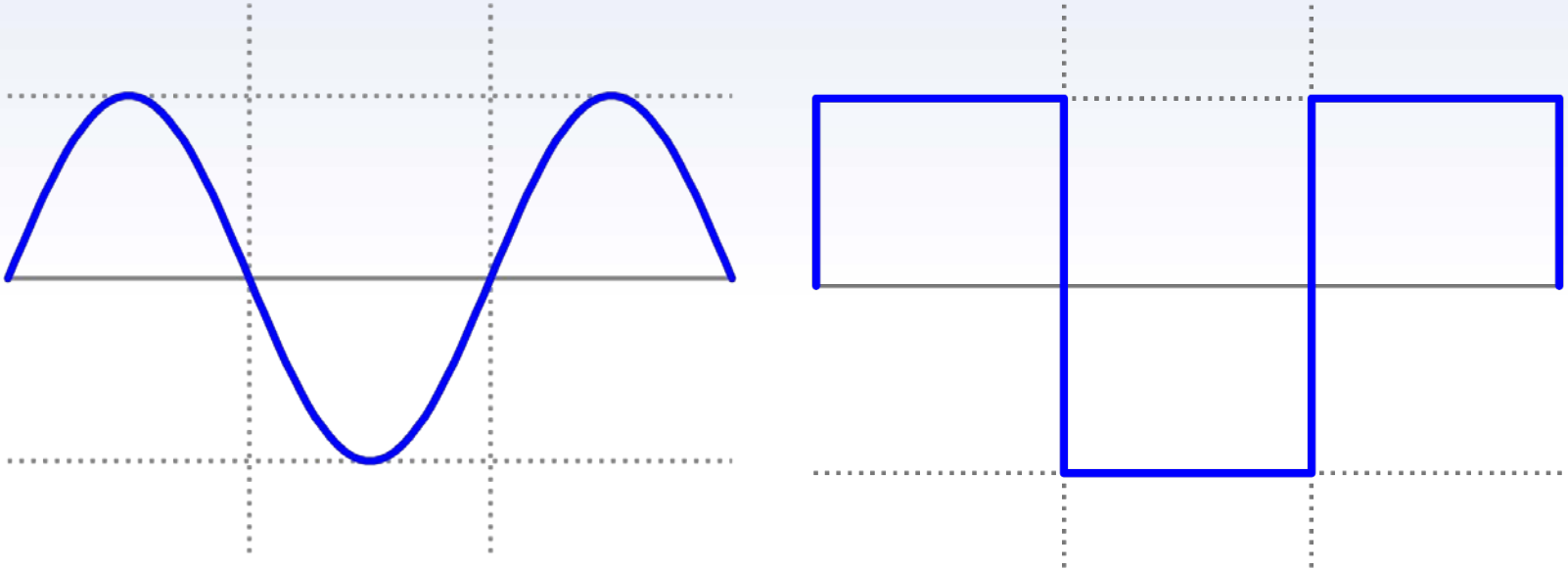
The 9th regular monthly dividend of twenty cents per share has this day been declared on the stock of this Company (200,000 shares) payable at the office of the Company on and after the 12th day of July to stockholders of record. Transfer books will close Wednesday, July 10th, at 3 o'clock p. m. and reopen Monday, July 15th, at 10 o'clock a. m.

J. L. TILTON, Secretary.

CENTRAL RAILROAD CO. OF NEW JERSEY
119 Liberty Street,
NEW YORK, July 8, 1889.

A dividend of one and a half per cent.

Gray Areas



Contractor's Responsibilities After Award

- Business Agent
- Shop Stewart
- Foreman
- Journeyman
- Apprentice

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Thank You!