Software is the Future of Irrigation Design

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Abstract. The future of irrigation design is in software, with highly-specialized CAD tools that dramatically speed the process of producing irrigation plans. The first, and most crucial element of irrigation design software, is the equipment database: all the varied manufacturers, with new and updated models, and wildly varying performance specifications. Further, all these pieces of equipment have to be matched with appropriate symbols to represent them on the plan. There needs to be tools to rapidly and easily place sprinklers and equipment, calculate their flow and pressure needs, indicate how they are to be piped, generate a legend, and most importantly, perform the flow hydraulics calculations to determine thie sizes of pipes required.

Programs such as Land F/X offer this, as well as advanced error-checking, resulting in the production of a plan in a fraction of the time it normally takes, and verified accurate to a degree never possible before.

Keywords. Irrigation software CAD

Why Use Technology?

I'd like to start with a brief story about the adoption of technology. A good example of this would be to go all the way back to the late 1800's. Those times saw the heyday of inventions, yet for the railroad industry, advancements in railcar coupling mechanisms and automatic brakes were not adopted. Even after a tragic crash that killed 29 passengers, it still took an act of Congress to mandate the use of such simple safety mechanisms. And after all the complaining from the railroad industry that such standards would bankrupt them, the new technology saw them benefiting with record profits and much-increased efficiency and safety after adopting the innovations.

In the same vein, some irrigation designers claim that they can produce a design quicker by hand than with software. While this may or may not be true, the indisputable gains from using software are in areas such as error-checking, revisions, redesigning the system for differing requirements or equipment, all done nearly instantly and perfectly accurate.

There are a number of irrigation software design programs out there – I am going to demonstrate the one I am most familiar with – in fact so familiar with it, I wrote every line of code in there. But let's suffice it to say that there are several programs which accomplish the same basic goal – that of the computer aiding the irrigation designer in the management of the many technical calculations necessary. Let me show you how computer software can automate and radically speed up the typical steps in developing an irrigation plan.

Selecting Equipment

The first stop is in equipment selection. Many irrigation designers can fall into the habit of continuing to specify the same equipment over and over. One reason for this, of course, is because they have seen the equipment in action and think it's a good product, but, more often than not, it's because it is too difficult to design with equipment they are not used to and don't have the performance data memorized.

This is just one of the many things that software can help with. These software companies spend vast hours updating their product with the latest models from each manufacturer, folding them into the system, logging the vast performance-related data, and creating graphical symbols to represent each piece of equipment.

Correctly designed software can allow you to quickly place any type of equipment, and not bother you with data and symbol requirements. First, is just managing the many various types of irrigation equipment, broken up into four overall categories: Heads, Valves, Auxiliary Equipment, and Drip Irrigation.

IA Expo Sample	
Irrigation Manager:	
⊙ Heads OValves OAuxiliary Equipment ODrip	
All Show Components	
All Lut South	
Shrub Spray	
Shrub Rotary O Heads O Valves Ausiliary Equ	auipment O Drip
Bubbler Turf Rotor	Show Components
Turf Impact	
Shrub Impact Remote Control Valve Valvein-Head Rotor Manual Control Valve	IA Expo Sample
Quick Coupler Valve Hose Bibb	Irrigation Manager:
Shut Off Valve Master Valve	O Heads O Valves O Auxiliary Equipment O Drip
Check Valve	All Show Components
Drain Valve	All Remote Control Valve
Source Data Pipe Data	Quick Couplet Valve
	Hose Bibb Shut Off Valve O Heads O Valves O Austiany Equipment O Drin
	Master Valve
Add Import Edit V	Air Relief Valve
	Pressure Reducing Valve Emitter Areas with Drip Tubing Individual Emitters with Drip Tubing
Source Data Pipe Data	Individual Emitters Hard-Piped
	Drin Control Valva
	Add Import Edit Zone Control
	Drip Air Relief Valve
	Source Data Pipe Data Drip Popup
l.	Single Uutlet Emitter Multi-Outlet Emitter
	Drip Tubing Area Single Outlet Emitter
	Area for Drip Spray Area for Drip Bubblers
	Area for Dripline
	Source Data Pipe Data Help Exit

The four basic categories – Heads, Valves, Auxiliary Equipment, and Drip – with the various associated types of equipment.

If I want to use a turf spray head on a project, I first see a list of manufacturers that have this type of head.

Select Manufacturer 🛛 🛛 🔀
Hunter Irritrol K-Rain Rain Bird Toro Weathermatic
OK Cancel

Selecting a Turf Spray head.

I just pick which manufacturer I want, and then decide which model I want that is offered by that manufacturer. I am able to view the page from the manufacturer's catalog for any piece of equipment, and am able to make a decision based up the model options I wish to use, leaving the software to determine the exact model number for me.

Select Series			
Institutional Spray PS Pro-Spray SRS	Turf Spray, 4" or 6" pop Turf Spray, 2" or 4" pop Turf Spray, 4" or 6" pop Turf Spray, 2", 3", 4" or -	oup, with drain check valve and purple cap option oup, adjustable to full circle oup, check valve with optional purple cap r 6" popup with optional purple cap	
	Select Model		
View Catalog	INST-04 INST-04-CV INST-04-CV-R INST-06 INST-06-CV INST-06-CV-R	4" popup 4" popup w/ drain check valve 4" popup w/ drain check valve, purple cap 6" popup 6" popup w/ drain check valve 6" popup w/ drain check valve, purple cap	
	View Data		Add to Project Cancel

Selecting a Series and Model of Turf Spray head.

After selecting a model I will need to decide which Design Pressure I want the head to perform at, and a good program will allow you to select from any of the design pressures and performance options that the manufacturer lists for that head type. Again, I can view the performance chart from the manufacturer's catalog with one click, to see how the Design Pressure will affect the gallonage and radius of the selected head.

PSI		
O 10		View Data
<mark>O</mark> 20	O 15	
○ 30	0 25	
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0 100		Cancel

Selecting a Design Pressure for the Turf Spray head chosen.

As I add a spray head, again I am just picking out the model options, and the design pressure – note that the software has assembled all the fixed-arc nozzles for me, as well as the variable-arcs, the strip sprays, the low-flow nozzles, and the specialty nozzles. All of these have unique symbols assigned to them, and their correct gallonage associated with them.

IA Expo Sample	X
Clirigation Manager:	
Heads OValves OAuxiliary Equipment ODrip	
Turf Spray	
Hunter INST-04-CV short radius nozzles 02H Hunter INST-04-CV short radius nozzles 02Q Hunter INST-04-CV short radius nozzles 04H Hunter INST-04-CV short radius nozzles 04Q Hunter INST-04-CV short radius nozzles 06H Hunter INST-04-CV adjustable arc 08A Hunter INST-04-CV 8' radius 08F Hunter INST-04-CV 8' radius 08F Hunter INST-04-CV 8' radius 08H Hunter INST-04-CV 8' radius 08Q Hunter INST-04-CV 8' radius 08Q Hunter INST-04-CV 8' radius 10F Hunter INST-04-CV 10' radius 10F Hunter INST-04-CV 10' radius 10F	
Hunter INST-04-CV 10` radius 10Q Import Edit View Data Delete Detail	
Source Data Pipe Data Help Exit	

The selected Turf Spray has been added to my project, with all available nozzles assigned symbols and ready to be placed.

So already, if I was in a situation where I had to use a head I had never used before, such as a short-radius strip spray, coupled to a valve the client wants to use, the fact that I don't have the manufacturer's catalog, or any experience with the equipment is irrelevant. The software is action as an information channel, much like the internet, making it easy for me as a designer to access and utilize product information I am unfamiliar with.

21 View Data											-		3						
Institutional Spr	av.												^						
institutional spra	ay																		
Rugged, water-saving sprinklers d	esigned for commercial,																		
institutional, and public area appli	ications.																		
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xceptional strength, innovative fe areas. Features like a positive-seal	aturesjust the need for hig flush cap with an innovative	h traffic		63	12	-		-	11										
design that keeps debris out. A hi	gh quality, multi-functional,	pressure-			111			ill Par											
activated wiper seal. True pressure regu mental and pressure conditions to redu	lation under a wide range of ce water waste. An in-stem r	environ-	101	IN 7	10				8										
that acts as a flow control device if the r	nozzle is removed. A super l	View Da	ata		-	95.em						-						-	
duty check valve assembly that eliminat	tes the potential liability iss																	- Constitu	1
lot in a spray sprinkler? How about one	more great feature-just like	Short F	Radius Nozz	les Perfo	rmance	Data													
Hunter Institutional Series" irrigation pr	oducts, it carries a 5-year w		Pressure	Color C	Code: Light Radius	Brown	Preci	p in/hr	Color Co	de: Light Gr Radius	een •	Precip	intr	Collor Co	de: Light B Radius	Ros •	Рте	olo in thr	
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(400)	Heavy-duty body a	_				0.10	0.00	10.00			0.00		0.00			1.00	0.00	0.11	
and the second s	Multi-thread buttre the harshest enviro	Pro-Spr	ay" Nozzles	Performa	nce Data														
and the second second				8 Foot Ra Fixed (Qua Trajectory	adius arter, Half, F r. 0*	ull) Nozzi	10 Foot Ra Fixed (Quar Trajectory:	idius ter, Halt, Full) 15°	Nozzle	12 Foot Ra Fixed (Quarti Trajectory: 2	dius Ier, Half, Full) 18*	Nezzle	15 Foot Rac Fixed (Quarte Trajectory: 21	r, Half, Fu P	n) Nezzie	17 Foot P Fixed (Qui Trajectory	tadius arter) 128°	Nozz	fa 7
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	Ratcheting riser fo	Adjusta	ble Arc Nozzl	es Perform	nance Da	ta			12.00										
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		-	40 1	0' 1.4	6 2.81	3.25	12' 1.4	6 1.95	2.25	14 1.6	8 1.65	1.91	17 2.1	16 1.1	1 1.74	19	2.76	1.47 1.70	

Viewing the manufacturer's catalog pages for various equipment.

In selecting other equipment, such as valves, again I can view catalog pages instantly, see performance curves, and make my selection without having to figure out the model number myself.

28 View Data		_ 0		
PE Catany PE Catany	PEB and PESB Series Y. 1%; 2; (2034, 4049, 5080) Danabe gass-filed rylon coast performance. Statistics steel stat thread damage. Scale Coast, and the state of the	extion for long life and reliable smoked unto the body resist material subsequent system longer life. v Data B and PESB Series Valv	re Pressure Loss (ps)
Image: Non-To-Specify and the system 100-170-188-0 100-170-188-0 100-170-188-0	- All and a factor at the constraint of the second of the	100-PEB In 15 05 1.0 1.3 1.7 1.8 2.9 5.6 10.0 15.6 0.0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0	150-PEB 1½" - - - 3.9 3.6 3.5 3.6 5.4 9.6 14.6 21.2 - -	200-PEB 2" - - - - - - - - - 4.8 4.5 5.2 8.2 11.8 15.5 19.5

Viewing catalog pages for a valve.

Head Placement

When placing heads, it is easy for me to place from a palette of up to six different spray types, and any number or rotors, rotators such as the MP Rotator, bubblers, impacts, etc., with the system automatically placing the correct symbol, and scaled automatically for me no matter what scale I will be plotting the drawing at. Keyboard commands let me toggle among the various radiuses and nozzles. In this way, the traditional method of using a circle template to design a system is mimicked by the system, yet is much faster.



Radius preview as I place my 15' Turf Spray head.



Spray symbols are automatically sized for the scale the drawing will be plotted at.



Using keyboard commands, I instantly toggle to a 12' radius preview.



I also have keyboard commands to decrease the radius, as if adjusting the radius screw on the nozzle.

GPM Total and Zoning

Now that I have placed the heads for my design, it is time to get into the GPM calculations, the area where the software provides the most dramatic improvements in speed and accuracy. I can total the GPM in the project with a single click.



GPM Total for the entire project.

As I zone the various areas, the totals are not prone to human error, I can easily adjust the zone boundaries to be instantly recalculated, and not to mention I am even saving paper by keeping this process entirely electronic.



Zoning the various areas of the site.

Piping and Error Checking

In order for a computer system to do my flow hydraulics and pipe sizing for me, it needs to know the order the heads are connected – this is essentially just an internalization of the pipe layout, as if we are teaching the computer the artificial intelligence of visual recognition. I draw the pipe as I would any line in the CAD system, yet the system is doing several things for me: it highlights the object I clicked on, so that I can easily see if I missed clicking on my target, and it also offsets the drawn pipe perfectly from the head symbol, for clarity of the plan.



Piping to heads, the pipe is offset perfectly from the head symbols, and the Yellow highlight lets me know that I click on the head.

In using a software system, I now have abilities I could never dream of doing any other way – for instance, I can click on any head, and the system will highlight all connected items, so that I can verify that the system is correctly piped, or just to see what system a head is a part of.



Highlighting all the connected items in a system.

And of course I will use the ultimate in error-checking – having the system automatically highlight for me any heads that are not connected to valves. This is a classic example of replacing a lengthy manual process with something that is not only instant, but 100% accurate.



Highlighting any heads that are not connected to a valve.

Pipe Sizing

Having a computer perform the intensive calculations for automatically determining the pipe sizes is very much the holy grail of irrigation design software. My input is reduced to determining a few simple factors, such as the type of pipe I am using, the maximum velocity of the flow I would like to use, and what the Pressure Variation between the first and last head is to be.



The factors used in sizing the pipe – note that for both lateral and mainline, my primary control is simply a slider to determine the maximum velocity of the water.

When you size a lateral system the software will do far more calculations than one would ever have the time or inclination to do manually. Since it knows the gallonage of each head, the desired Design Pressure, and the exact distance between heads, it can perform the actual flow hydraulics according to the Hazen-Williams equation considering the flow, the inside diameters and coefficient of the type of pipe you indicated, and the maximum water velocity selected. It also has the ability to perform this calculation over and over again as necessary, adjusting the velocity of water until the required sizes of pipe result in the system having balanced pressure (within the Pressure Variation Factor determined by the user).

In fact, the system is even able to calculate the exact precipitation rate for each station. For spray heads it uses the aggregate area of the station divided by the exact gallonage. And for rotor heads it can automatically determine if my rotors are at square or triangular spacing, and even factor in the effect of similar rotor heads from a different lateral that are spraying onto this station's areas. Nothing will ever replace the seasoned design professional, who has viewed different types of heads in action, and can make the best determination of what kind of water to apply to different situations. Let the human do what a skilled human does, and let the computer do the intensive mathematical operations and organize the vast amount of data.



The system has sized all the appropriate pipe, and placed labels as necessary.

Sizing Mainline

As we get to sizing the mainline, again we have to leave the intelligent designer in the loop. It is up to the designer to know an appropriate maximum velocity they wish to use, or, if they are sizing for multiple valves to operate at once, to select an appropriate fixed GPM to size all pipe consistently.

The system can automatically detect how a valve will be receiving water, even automatically detecting a loop and determining the exact correct ratio to split the flow. It again will size the pipes using the Hazen-Williams formula for the type of pipe and desired velocity, but is able to adjust the velocity if necessary and resize all pipes, in a seemingly instant process. When complete, it can provide me with a Critical Analysis showing all pertinent data.

Critical Analysis	
FLOW AVAILABLE Water Meter Size: Flow Available:	1-1/2'' 65.00 gpm
PRESSURE AVAILABLE Static Pressure at POC: Elevation Change: Service Line Size: Length of Service Line: Pressure Available:	87.00 psi 5.00 ft 2'' 20.00 ft 84.00 psi
DESIGN ANALYSIS Critical Station Flow: Flow Available at POC: Residual Flow Available:	55.00 gpm 65.00 gpm 10.00 gpm
Pressure Req. at Critical Station: Loss for Fittings: Loss for Main Line: Loss for POC to Valve Elevation: Loss for Backflow: Loss for Water Meter: Critical Station Pressure at POC: Pressure Available: Residual Pressure Available:	63.10 psi 0.25 psi 2.52 psi 0.00 psi 12.10 psi 3.90 psi 81.87 psi 84.00 psi 2.13 psi
	ОК

The Critical Analysis is able to show every piece of data used in sizing the Mainline.

The great thing about advanced software is that you can quickly adjust to a system that ends up being short on pressure. Suppose that after sizing your mainline, your distant rotor valves are now short 3 or 4 psi. Rather than add a booster pump, simply slow your water down and decrease your Pressure Variation. Slow your velocity on lateral lines from 5 ft/sec. to 3.75 ft/sec., and change your Pressure Variation from 20% to 10%. Both of those will result in larger pipe sizes, but that also means less pressure loss. Thus a complete resizing of several systems, and resizing the mainline, updating dozens if not hundreds of labels, is done by clicking a couple buttons in mere seconds.

Creating a Legend

When I generate a legend or schedule with a software system, I have the benefit of exact quantities, for whatever equipment was actually used in the project. I am able to instantly adjust to any variety of equipment, even if I have never used it in a project before. My lineal feet quantity of pipe is even far more accurate than any other possible method, as it is totaling the length between each insertion point of connected item. Again, my accuracy at this point is near perfect, and the time comparison is from a couple hours traditionally, to instantly by using an advanced software system.

SAMBOL	MANUEACTUREDA		TION	OTY	DEL	DETAN						
STMBUL	MANUFACTURER/N	OUEDDESCRI	TION	UIT	Pal	DETAL						
Q T H F	Rain Bird 1804-SAM Turf Spray 4" popup	PRS 10 Series N with check valve	/IPR and pressure regulator.	2	30	1/L301						
	Rain Bird 1804-SAM Turf Spray 4" popup	PRS 12 Series N with check valve	/IPR and pressure regulator.	19	30	1/L301						
	Rain Bird 1804-SAM Turf Spray 4" popup	PRS 15 Series 1	/PR	22	30	1/1.301						
	Dute Diel 1904 CAM	BOOKL										
4 5 8 10 12 15 18	Turf Spray 4" popup	A	1	В			C	D	E	F	G	H
	D-1- 0-1 (012 OIL)	1 SYMBO	MANUFACTURER/	MODEL	0.00		QTY	ARC	PSI	GPM	RADIUS	
EST LOS ROS OST SET	Shrub Spray 12" pop	2	Rain Bird 1804-SAI	M-PRS 10	Series MPR		1	360	30	1.58	10'	
	and the second	3	Rain Bird 1804-SAI	M-PRS 10	Series MPR		1	180	30	0.79	10'	
$\bigcirc \bigcirc $	Rain Bird 1812-SAM Shruh Shray 12* nor	4	Rain Bird 1804-SAI	M-PRS 12	Series MPR		9	360	30	2.6	12'	
	cando opray 12 pop	5	Rain Bird 1804-SAI	M-PRS 12	Series MPR		7	180	30	1.3	12'	
Q Q 👷 🖶 🛉	Rain Bird 1812-SAM	6	Rain Bird 1804-SAI	M-PRS 12	Series MPR		3	90	30	0.65	12'	
	Shrub Spray 12 pop	7	Rain Bird 1804-SAI	M-PRS 15	Series MPR		8	360	30	3.7	15'	
000000	Rain Bird 1812-SAM	8	Rain Bird 1804-SAI	M-PRS 15	Series MPR		11	180	30	1.85	15'	
O T H II IO F	Shrub Spray 12" pop	9	Rain Bird 1804-SAI	M-PRS 15	Series MPR		3	90	30	0.92	15'	
	Rain Bird 1812-SAM	10	Rain Bird 1804-SAI	M-PRS 10	Series VAN		1	Adj	30		10'	
OTHITTOF	Shrub Spray 12" pop	11	Rain Bird 1804-SAI	M-PRS 12	Series VAN		11	Adi	30		12'	
	Rain Bird 1812-SAM	12	Rain Bird 1804-SAI	M-PRS 15	Series VAN		9	Adi	30		15'	
4 6 8 10 12 15 18	Shrub Spray 12" pop	13	Rain Bird 1812-SAI	M-PRS 15	Strip Series		14	EST	30	0.61	4'x15'	
A A	Molla Molla MD1000	14	Rain Bird 1812-SA	M-PRS 15	Strin Series		18	SST	30	1.21	4'x30'	
	Shrub Spray 12" pop	15	Pain Bird 1912-SA	M.DDC Q	Sorios MDR		2	260	20	1.05	Q1	
	adj arc 90 to 210, O=	15	Rain Bird 1012-3A	M DDC 0	Series MPR		4	100	20	1.05	0	
000	Walla Walla MP2000	10	Rain Bird 1812-SAI	M-PRS 8	Series MPR		0	180	30	0.52	8	
~~~	Shrub Spray 12" pop	1/	Rain Bird 1812-SAI	M-PRS 8	Series MPR		2	90	30	0.20	8	
	arc 90-210, G=Green	18	Rain Bird 1812-SA	M-PRS 10	Series MPR		5	360	30	1.58	10'	
	Bird 1812 body.	19	Rain Bird 1812-SAI	M-PRS 10	Series MPR		2	180	30	0.79	10'	
		20	Rain Bird 1812-SAI	M-PRS 10	Series MPR		3	90	30	0.39	10'	
SYMBOL	MANUFACTURER/N	21	Rain Bird 1812-SAI	M-PRS 12	Series MPR		2	360	30	2.6	12'	
(42)	Hunter I-40-ADS, 36	22	Rain Bird 1812-SAI	M-PRS 12	Series MPR		17	180	30	1.3	12'	
$\bigcirc$	Turf Rotor, adjustabl	23	Rain Bird 1812-SAI	M-PRS 12	Series MPR		14	90	30	0.65	12'	
	stainless steel riser	24	Rain Bird 1812-SAI	M-PRS 12	Series MPR		1	120	30	0.87	12'	
$\triangle$	Hunter PGH-ADV, 38	25	Rain Bird 1812-SAI	M-PRS 12	Series MPR		3	270	30	1.95	12'	
	Shrub Rotor, 12" pop	26	Rain Bird 1812-SA	M-PRS 15	Series MPR		1	360	30	3.7	15'	
6	valve	27	Rain Bird 1812-SAI	M-PRS 15	Series MPR		6	180	30	1.85	15'	
$\triangle$	Hunter PGH-ADV, 38	28	Rain Bird 1812-SAI	M-PRS 8	Series VAN		2	Adi	30		8'	
	Shrub Rotor, 12" pop	29	Rain Bird 1912-SA	M-DRS 10	Series VAN		9	Adi	20		10'	
7	Taire	20	Pain Bird 1912 SA	M DDC 11	Series VAN		0	Adi	20		10	
$\Delta$	Hunter PGH-ADV, 38	30	Rain Bird 1012-SA	M-PR3 12	Series VAN		9	Auj	30		12	
	Shrub Rotor, 12" pop valve	31	Rain biru 1012-SA	WI-PRS 13	Series VAIN		3	Auj	50		15	
		32	walla walla MP10	00 W/ 18	12		3	Adj	40		13	
SAMBOL	MANUEACTUREDA	33	Walla Walla MP20	00 w/ 18	12		10	Adj	40		19'	
STWDOL	MANOLACTORER/I	34	Walla Walla MP20	00 w/ 18	12		5	360	40	1.47	19'	
<b>S</b>	Rain Bird PEB	35 SYMBO	MANUFACTURER/	MODEL			QTY		PSI	GPM	RADIUS	
	Rain Bird 3RC	36	Hunter I-40-ADS, 3	36S			48		50	11	51'	
-		37	Hunter PGH-ADV,	36V			1		40	1.4	33'	
(BL)	Febco 825Y 1-1/2"	38	Hunter PGH-ADV,	36V			11		40	2.4	36'	
	Water Meter 1-1/2"	39	Hunter PGH-ADV,	36V			2		40	3	38'	
		40 SYMBO	MANUFACTURER/	MODEL			QTY					
	Irrigation Lateral Line	41	Drip Tubing									
	Irrigation Mainline: P	42	Rain Bird XBS									
	Valve Callout	43 SYMBO	MANUFACTURER/	MODEL			OTY					
-	Valve Number	44	Rain Bird DEP 1"									
(#*)#*-	Valve Flow	44	Date Dird DED 1 1/	28			10					
#**		40	Rain Bird PEB 1-1/	2			19					
		40	Rain Bird 3RC				1					
		47	Febco 825Y 1-1/2"				1					
		48	Irrigation Lateral L	Ine: PVC	Class 200 SDR 21	8/4"	z482					
		49	Irrigation Lateral L	ine: PVC	Class 200 SDR 21 :		1541					
		50	Indention Internel I	1	AL		0.07					

*Irrigation Schedule, placed into the drawing with symbols, or sent to a spreadsheet for cost takeoff purposes.* 

### **Making Changes**

The last portion of a project that a software system can assist with is in making changes. I have tools at my disposal to easily move heads along with any connected pipe, or to delete all the pipe for a system, or to replace symbols or equipment. And of course after making any number of changes, no matter how complicated, resizing my pipes and regenerating my schedules is instantaneous.

# Conclusion

Other software tools that we use daily have the convenience of things such as Find and Replace, and Spellcheck – now advancements made with standardization of CAD software, and advanced database technologies have allowed the creation of highly specialized software tools for irrigation design.

Incorporating advanced technology such as this will allow us to not only be more accurate, efficient, and allow more flexibility, but will make our profession more productive and profitable.

# References

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