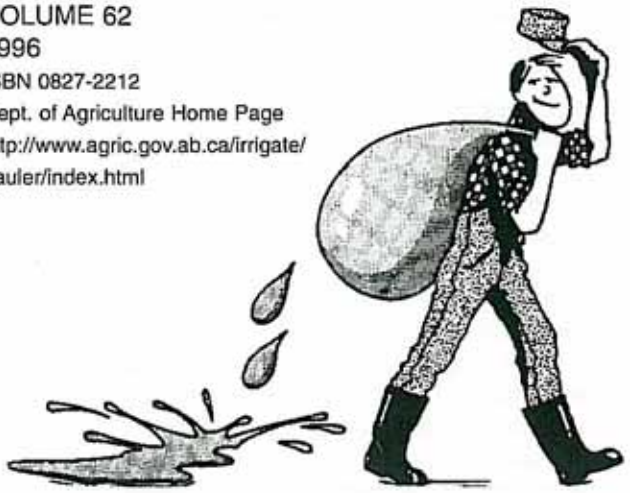
the
WATER HAULER'S BULLETIN

VOLUME 62
1996
ISBN 0827-2212
Dept. of Agriculture Home Page
http://www.agric.gov.ab.ca/irrigate/hauler/index.html



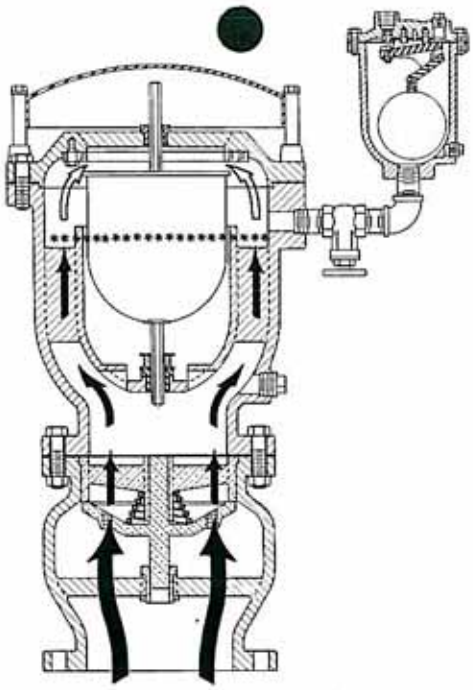
IN THIS ISSUE:

Water Hammer in Irrigation Delivery Pipelines

Water hammer - that loud banging when you close the water faucet suddenly - is of concern to those who design and operate irrigation water delivery pipelines. The loud banging in your water lines is an indication of a pressure surge, and it is the pressure surge that can be damaging to pipelines, says Gordon Ayers, P. Eng. with MPE Engineering Ltd.

Pressure surges, or hydraulic transients, are caused by some relatively sudden change in flow. This can be from a valve closing or opening, an air release or vacuum valve being operated, cavitation or the collapse of an air pocket in the line, or, of most concern in irrigation applications, a power outage which suddenly shuts down all the electric pumps on the pipeline.

Pipelines have become more prevalent in southern Alberta as the preferred alternative for rehabilitation of earth canals. Pipelines offer many advantages, including lower maintenance, more responsive water delivery, and reclamation of the land once occupied by the canal, says Ayers.



Typical air release valve.

However, pipelines offer their own set of challenges to the designer and operator, including the issue of pressure transients. Designers have been aware of water hammer for many years and have typically taken a simplified approach based on the conservation of momentum equation. The equation used by most designers takes the form of:

$$\Delta H = \frac{a\Delta V}{g}$$

where ΔH is the rise in pressure head, a is the speed of a pressure wave in the pipe material, ΔV is the change in velocity of the fluid, and g is the gravitational constant. This equation is applicable for the first pressure wave that is generated.

In most cases, the simplified equation above is adequate to address the expected pressure rise in a pipeline. Most irrigation pipelines are single line or simple branching systems, and the velocities (ΔV) are relatively low. Also, the pipe material has a dramatic impact on the hydraulic transients. The pressure wave speed in concrete and steel is much higher than in PVC or polyethylene. With a lower wave speed (a) the expected pressure rise is lower as well.

What this equation does not take into account is the dynamic nature of transients. Pressure waves are reflected at major discontinuities in the pipeline, including at entrances/exits, changes in diameter, and branches or tees. Reflected waves can cancel or coincide with subsequent waves and significantly affect the pressure fluctuations experienced in the pipeline.

Some pipeline networks call for a more sophisticated approach to transient analysis. An example of this is the Bow Island Lateral 20 system in the east block of the St. Mary River Irrigation District (SMRID). Lateral 20 is a large pipeline network that is being constructed over a three-year period. When complete, it will serve more than 6,000 acres of irrigation, incorporate 27 km of pipe, and carry a maximum flow of 3.85 m³/s. Because of the many branches and the 35-m drop in elevation, the district was concerned with the potential for water hammer, especially during a power outage when the majority of turnouts would suddenly stop taking water.

The original design of the Lateral 20 pipeline called for concrete pipe for the initial 2 km, and PVC pipe in various sizes thereafter. To counter the effects of water hammer, an air relief stack was designed near the end of the concrete pipe. "The function of the air relief stack," says Ayers "which is simply a vertical steel pipe open to atmosphere, is to absorb the pressure fluctuations that may arise during normal operations and from unusual events such as a power outage."

An alternative design was proposed that replaced the large diameter concrete pipe with twin PVC lines, and also eliminated the air relief stack. The twin PVC pipes were estimated to be less expensive than the single concrete pipe and, obviously, the cost of the air relief stack would be avoided. The issue was whether the hydraulic transients would be effectively handled in either case.

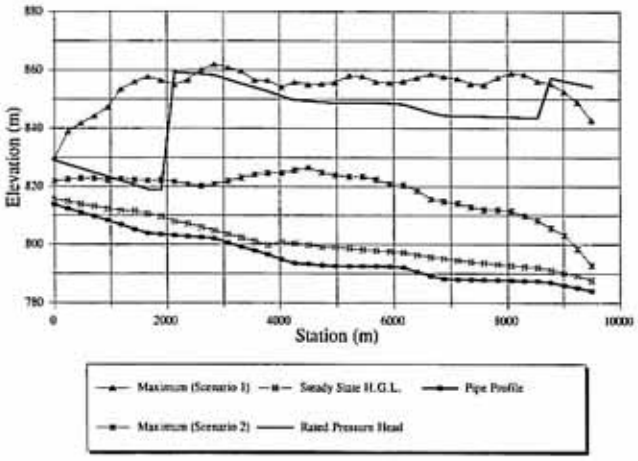
A comparative analysis of the alternatives was carried out to determine how the different pipe materials and designs would respond. Three cases were examined: concrete pipe with no air relief stack, concrete pipe with an air relief stack and twin PVC pipes in place of the concrete pipe.

Two simulation scenarios were set up for each alternative. "The worst case scenario," says Ayers, "had all turnouts directly connected to electric pumps and the system subjected to a power outage. At two locations the pipeline discharges into an open canal and these points were assumed to continue to deliver water."

"The second scenario, the most probable scenario, includes about half of the turnouts directly connected to electric pumps and the other half discharging into dugouts or connected to gas-powered pumps," states Ayers. When a power outage occurs, only the turnouts directly connected to electric pumps would shut off immediately.

The three graphs show the maximum transient pressures experienced by each of the pipeline alternatives for the two scenarios described above. Graph 1 shows the results for the concrete pipe with no air relief stack, Graph 2 shows concrete pipe with an air relief stack, and Graph 3 shows the results for the PVC pipe.

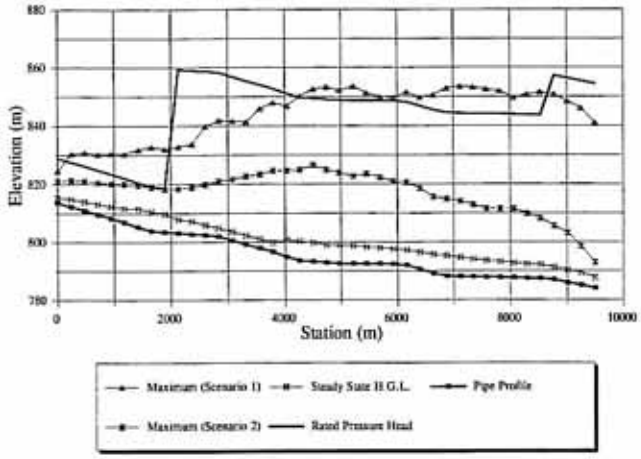
Graph 1 - Concrete Pipe, No Air Stack
SMRID Lateral 20 Main Line



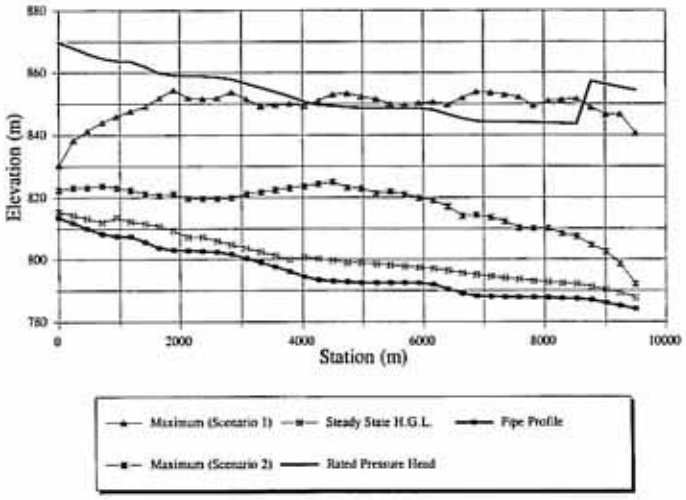
Graph 1 demonstrates that without an air relief stack, the pressure rise in the concrete pipe exceeds the pressure rating significantly. The pressure rise also exceeds the rating of the PVC pipe further down in the pipeline, although the rise is less significant. For the more probable Scenario 2, the pressure rise is much reduced and barely exceeds the pressure rating of the concrete pipe. Thus, if the number of direct-connected electric pumps could be assured to stay the same, then the air relief stack may not be necessary.

In Graph 2, for the worst case scenario (Scenario 1), the concrete pipe with the air relief stack in place does still exceed the pressure rating of the pipe. In the initial 2 km, the pressure rise is up to nearly double the pipe rating. In the lower reaches of the pipeline, where the pipe is PVC,

Graph 2 - Concrete Pipe, c/w Air Stack
SMRID Lateral 20 Main Line



Graph 3 - PVC Pipe
SMRID Lateral 20 Main Line



the pressure exceedance is nominal. The situation is much improved for the more probable case (Scenario 2). The pressure rise does not exceed the rating of either the concrete pipe or the PVC pipe further downstream.

Graph 3 shows that the PVC pipe performs better in the initial reaches because it has a higher pressure rating than concrete pipe, although for Scenario 1 it too experiences pressures nominally above the rating of the pipe in the lower reaches. For Scenario 2, with only half of the turnouts directly connected to electric pumps, the PVC pipe pressure rise is much below its rating. Therefore, in this case the evidence suggests that the lesser cost PVC pipe will perform adequately with respect to water hammer.

Ayers concludes that the hydraulic transient analysis of this large pipeline network confirms the designer's assumptions about the performance of the system when subjected to water hammer.

For more information please contact Gordon Ayers, P. Eng., MPE Engineering Ltd., 2220 5 Avenue South, Lethbridge, Alberta, Canada T1J 4G6. Telephone (403) 329-3442. ■

Slip-form Concrete Liner Repair

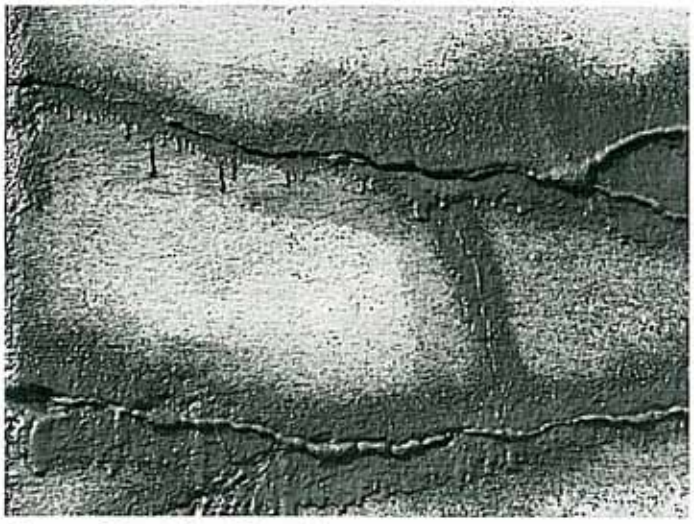
Repair of concrete slip-form lining using ArmorThane® was done on Lethbridge Northern Irrigation District (LNID) South Park Lake lateral in the fall of 1995 as described in the Water Hauler's Bulletin #58. In May 1996 the repairs were evaluated with the following results:

A total of 32 concrete panels, 2.5 m in length, was repaired (not 39 panels as originally reported). All cracks are located in a cut section and on the west side of the lateral. The cracks ranged in width from 1 to 25 mm. Approximately 1 to 2 mm layer of ArmorThane® 150 mm wide was applied over the cracks. Preparation of the cracks was done as follows:

	No. of panels primed with primer	Not primed
Cracks taped over with masking tape	5	9
Cracks not taped	8	10
Total number of panels	13	19

- 29 panels were sandblasted
- 3 panels were pressure washed
- 3 panels were treated with flexible polyurethane foam instead of a layer of ArmorThane®.

ArmorThane® being applied onto cracks on concrete-lined canal.



Closeup of ArmorThane® in cracks.

There seems to be no significant difference in adhesion of polyurethane to the concrete, whether it is primed, not primed, sandblasted, or pressure washed, states Svat Jonas, P. Eng. with the irrigation branch. The main contributing factor to its excellent adhesion, regardless of bed preparation, is the fact that the concrete was very porous. Sandblasting may be required where the concrete is not porous enough or smooth.

There was no evidence of cracking of the coating either with or without tape, although taping cracks with 50-mm wide masking tape will provide a bridging area for proper coating expansion and contraction. Several cracks were observed in the area repaired with polyurethane foam. The reason is that foam does not have enough tensile strength to allow for any movement of the concrete slab and perhaps it gets more brittle in low temperatures. Otherwise, there was no evidence of lifting of the coating in the entire test section.

Jonas concludes that the results from this project indicate that the ArmorThane® coating can be a viable repair material for cracks on concrete lined canals. Kevin Morris, district superintendent, is satisfied with the results but he would like to see the price of the material significantly lower. According to Steuart Scott of Scott Industries, the price could be as low as the price of rigid urethane foam which is being used to repair cracks at the present time. The quantity of ordered material is a deciding factor. According to Scott, district personnel could be trained to do repairs on their own. Required equipment could be rented or purchased. Results of this test showed that expensive sandblasting would not be necessary in a majority of the cases. The durability and flexibility of ArmorThane® coating compares to the traditional urethane foam and could make repairs cheaper in the long run, concludes Jones.

For more information please contact Svat Jonas, P. Eng., Irrigation Branch, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Lethbridge, Alberta, Canada T1J 4C7. Telephone (403) 381-5870. ■

Internet in Agriculture: Three Perspectives

Editor's Note: This is Part Three of a three-part series.

A Client's Perspective

At the beginning of March 1995, an Internet pilot project was implemented by Alberta Agriculture, Food and Rural Development (AAFRD) and was on line June 1. The pilot, centred around "Barley," continued until August 31 when an evaluation was completed. About 75 farm producers and farm suppliers tested the newly developed WWW site. Since then AAFRD has created one of the most comprehensive and fastest growing Agricultural Web sites in the world. **<http://www.agric.gov.ab.ca/>** "Electronic delivery of information must and does fit within the department's business plan" states Ron Weisenburger, the project's coordinator. He goes on to say, "Some of the anticipated results from the new electronic delivery include strengthening customer service, transfer of information and technology, and electronic access to specialists."

"Creating information is costly and time consuming, however, once it has been created, packaging it for delivery on the Internet is relatively quick and inexpensive. Once it is on the Internet, the actual costs of delivery are minimal since the user pays the access costs," says Weisenburger.

But what about the clients, those farm producers who will rely on this information. What information do they see as necessary for their day-to-day operations? Among the 75 farm producers who tested the pilot site were Mr. Wayne Mikkelson from Langdon and Mr. Rick Thiessen from the Strathmore area.

Mikkelson manages a feedlot/irrigation farm. He is most impressed with the diversity of topics. Mikkelson comments, "There is so much information out there that you could not access before! What's amazing is so much information is available and free." Mikkelson now accesses market information, weather reports and crop protection information on the Internet, which he feels is saving him time. Mikkelson states "There just isn't anything out there you cannot find on the Internet, except for the words or music for a particular music piece," — which he is sure is still out there. "I see this as an amazing source of information and education, putting buyers and sellers together by searching topics."

Thiessen also owns and operates a cattle feedlot/ irrigation farm and is the LNID board chairman. He is very impressed with how much information has been added over the past year. "I take it back when I said there wasn't much information on the Internet, you have done a lot with this site, keep up the great work!" Thiessen faces the same paper management problems the rest of us deal with. "The

problem is I get so much information that it is unrealistic to keep it and file it. Now I will be able to rely on the Internet to remain current with information."

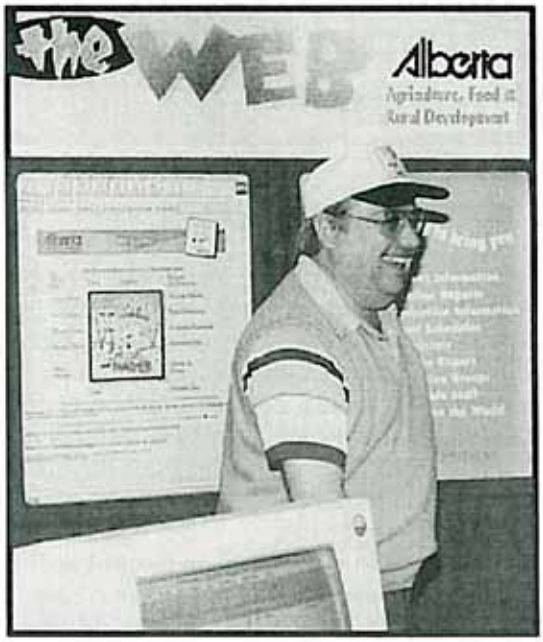
Thiessen explains that "Technology has replaced a lot of one-on-one visits for me, now that I can expect someone to post the information, I can view it at my convenience." One of the best ways to explain information is through the use of graphics. Thiessen says "Graphics do take longer to download but like the old saying, a picture is worth a thousand words but the graphics add relevance to the text and make the text much clearer."

So what else are irrigators looking for? Thiessen says, "Crop varieties should stay current, find out who the researchers are and what they are doing." He also sees the need for calculator programs that will allow an irrigator, for example, to do preliminary designs. At present many search engines will do a summary of available topic-specific information. "There is no longer any lag time with the Internet" says Thiessen. "With the phone, the other party is not always in. Then it is time to 'go on the Net'."

A new user of the Internet, since April '96, is John Kolk from Picture Butte. Kolk manages a poultry/irrigation farm. He finds without question the ability to contact the right people is much easier, as well as awareness of up-to-date issues and events. "It is getting to the point where you need information instantly and the Internet provides that." Kolk explains that he looks forward to accessing real experts, equipment manufacturers/suppliers, better market information, market opportunities for niche markets and commodity information. Kolk estimates that this communication tool will assist in connecting the buyer with the seller. Kolk says "For example, if a farm producer has on stock low acid flax, somewhere there is a buyer looking for this particular product. The trick is to be able to connect both parties; the Internet has the potential to do this. Right now the Internet is fascinating on a superficial basis. It is presently an immature medium. I see a lot of sharing of information. The infrastructure of information will be the fluff of the Internet; the real meat will be the connection of people." "The Internet will be a great feature for farm producers to connect to other farm producers" states Kolk. He explains that in Abbotsford, there are some poultry farmers who faithfully meet for coffee every day to discuss the latest in the industry. This group is probably the most aggressive and progressive poultry producers in Canada. The Internet can help do this same concept but distance will no longer be a barrier.

Kolk says "It would be nice to go one step farther by having available a cyber librarian, someone to sort through the information. So far I have not found many sites that have a high level of information. The information is still shallow but I realize that this is just the beginning. For agriculture, we need to be able to ask the expert including experts outside the department."

Is this new access to information worth it? Kolk says, "I am willing to pay for detailed information." Kolk flags a warning by saying, "Let's remember, at the end of the day, the Internet is still only a tool. People like to use technology



Ron Weisenburger standing next to "Ropin' the Web" display unit.

as an answer but it can never be that. The Internet is not the magic bullet. You still have to get the information, evaluate it, and apply it to your situation."

For further information on marketing the Internet and providing customer focus, please contact Ron Weisenburger, J.G. O'Donoghue Bldg., Edmonton, Alberta, Canada T6H 5T6. Telephone (403) 422-1821 or Fax (403) 427-3005. E-mail: weisenb@agric.gov.ab.ca ■

"Ropin' the Web's" official logo.

Electronic Data Gathering

How small can they get?

A palm-sized, DOS-based, hand-held computer for down loading field data was unimaginable five years ago, says Brian Cook, an electronics technologist with the irrigation branch. Until this past summer, Lap Top computers were the latest and best method of collecting, storing and transferring data from field stations back into the office computers. Things changed with the purchase of a Hewlett Packard 200LX hand-held computer.

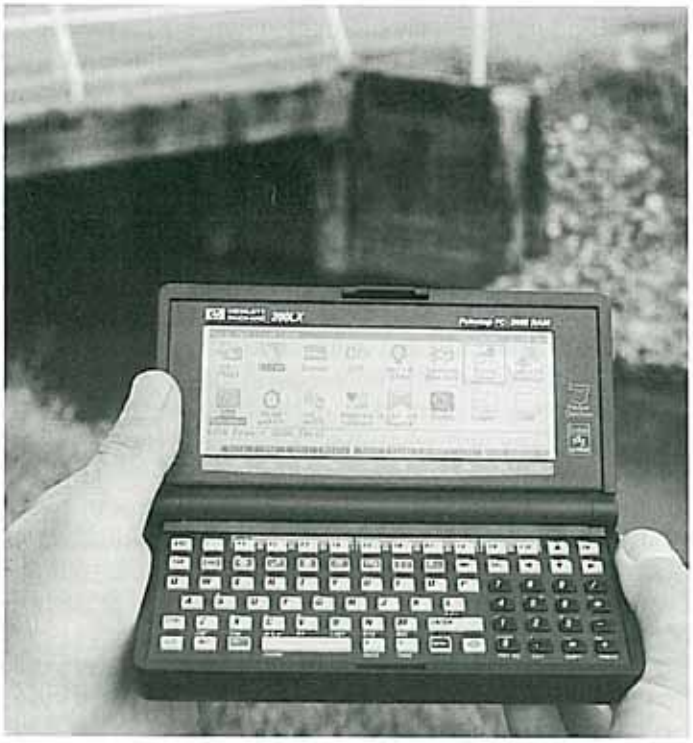
Anyone who has used the much larger Lap Top computers in the field knows, says Cook, that in spite of their power and portability they have several disadvantages. These include size, weight, limited battery life, along with disk drives and hard drives that can be damaged by field handling, dust and rain. Inexpensive Lap Tops suitable for field use are becoming harder to find, states Cook. Fortunately Hewlett Packard and Psion have each released a small Palm Top computer that are ideal for field use. Both are priced less than $1000. The computers are very similar in size, battery use, com ports, and DOS compatibility with up to 2MB internal RAM expandable to 20MB.

The Hewlett Packard 200LX is 6.25" x 3.375" x 1" with a lithium backup battery and is powered by two 'AA' batteries capable of up to six weeks' use.

Built-in features include:

- Serial Communication Port
- Infrared Communication Port
- PCMCIA 2.0 type I or type II Port which supports memory cards, fax cards or serial port cards
- Built-in Software:
  - Appointment Book
  - Phone Book
  - Pocket Quicken
  - Memo Editor
  - Note Taker
  - World Time
  - Stopwatch
  - Database
  - Financial Calculator
  - Lotus 1-2-3 ver. 2.4
  - File Manager

All this, and the fact that there are no moving disk drives or hard drives, combines to make this Palm Top an extremely useful field data collecting terminal and field notebook.



Palm-sized computer used for down loading field data.

"For use as a data terminal, its small size and long battery life plus simple loading DOS-based data logger software, make it ideal," states Cook. All that is needed is a simple cable adapter to plug into the data logger, with the addition of a five or 10 Meg memory card, several additional programs or spreadsheets can be loaded to process data in the field.

As a field notebook, it has a useful memo taker, database and appointment manager programs which are all DOS based and easy to use. With a Lap Link program and cable, field notes can easily be transferred to a desk top computer, states Cook.

"Its main drawbacks are limited memory, a small screen and keyboard. The keyboard has a nonstandard placement of function keys, but this is minor to the many advantages. When buying computers for field use, irrigation districts should look at the new palm-sized," concludes Cook.

For more information please contact Brian Cook, Electronics Technologist or Bob Riewe, Irrigation Soil and Water Specialist; Irrigation Branch, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Lethbridge, Alberta, Canada T1J 4C7. Telephone (403) 381-5170. ■

Alberta Irrigation Projects Association Annual Conference '96

The Alberta Irrigation Projects Association (AIPA) in conjunction with the University of Lethbridge, Water Resources Institute, will be holding a joint working conference November 24-28 at the Lethbridge Lodge Hotel. Conference chairman, Rick Ross, says "this year's theme is ***Problems in Search of Solutions.***" For more information please contact conference secretary Verna Lees.

Telephone: (403) 328-3063
Fax: (403) 327-1043
E-mail: aipa@agt.net

■

Surface Water Quality Being Studied in the Crowfoot Creek Basin

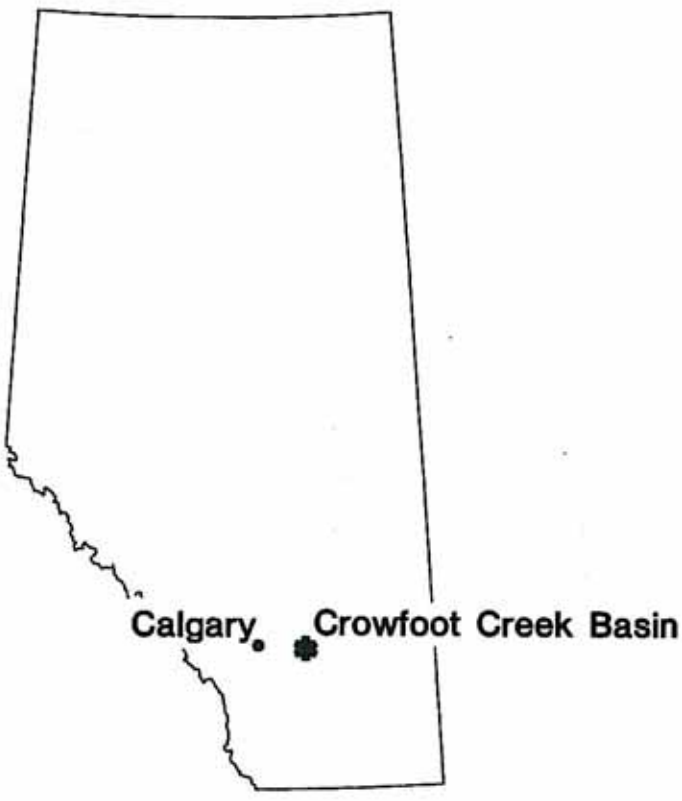
A major four-year study was initiated in 1996 on the Crowfoot Creek watershed east of Calgary, to determine if agricultural practices are contributing to deterioration of water quality in the creek, a tributary of the Bow River. Gary Buckland, one of the project leaders, reports that the main contaminants in the Bow River within the reach where the Crowfoot Creek discharges were described by the Bow River Water Quality Task Force in 1991 as nutrients, bacteria and trace elements. Preliminary monitoring conducted by Madawaska Consulting in 1995 confirmed the presence of high concentrations of fecal coliform bacteria and total phosphorus in Crowfoot Creek.

Water quality concerns in Crowfoot Creek resulted in the formation of a study team consisting of Wheatland County, the Western and Eastern Irrigation Districts, Ducks Unlimited, the Village of Standard, local producers, irrigation branch (Alberta Agriculture, Food and Rural Development), and surface water quality assessment branch (Alberta Environmental Protection). About 70 people attended a public meeting in Standard last April wherein the project was introduced. Buckland stated that support from landowners adjacent to the creek was excellent and full approval was given to proceed with the study.

The Crowfoot Creek watershed is located east of the town of Strathmore in Wheatland County, and comprises an area of mixed irrigated and dryland agricultural production of about 1600 km². Natural flows in the creek originate as runoff from snowmelt or high rainfall. Flow in the creek is augmented from May to October by deliveries or spills of irrigation water from the Western Irrigation District. Water from Crowfoot Creek and downstream in the Bow River is used for irrigation, livestock watering, domestic use, wildlife habitat through constructed wetlands, and recreation. Downstream users along the Bow River include the Eastern Irrigation District, the Siksika Nation, the City of Medicine Hat, residents of several small communities and local producers.

A network of 25 sites was established in 1996 to measure flow and to assess water quality. Sites were selected on the basis of a preliminary assessment of land use and on consultations with local producers, Wheatland County, Ducks Unlimited, the Western Irrigation District and the Village of Standard. Flow is being determined at all sites, of which 19 are automated using stilling wells and dataloggers. The other flow monitoring sites use staff gauges for flow measurement. Flow is estimated at all sites by manually metering flow and developing stage-discharge curves that relate discharge to height of water in the channel. Water sampling will be conducted at all sites daily during spring runoff and weekly from early May to late October.

Automatic (ISCO) water samplers, which collect composite samples over a 24-hour period, are set up at 11 sites where flow is continuous or quality is expected to vary



Location Plan.

Crowfoot Creek Site 10, showing tipping bucket rain gauge, stilling well enclosure, ISCO sampler enclosure, and ISCO sample intake line.

significantly. These samplers are programmed to respond to changes in flow, such as following a high rainfall event with runoff, and take a composite sample during the event. Grab samples are taken at the remaining 14 sites for weekly and event sampling. Water samples will be analysed for nutrients (nitrogen and phosphorus), salinity and bacteria (fecal coliforms and *E. coli*). Additional analyses will include testing for nine soluble trace elements three times per year, and testing for 31 different pesticides at selected locations for eight consecutive weeks in 1997. Water samples collected daily (six days per week) by the Eastern Irrigation District from the outlet of the watershed are also being analysed for fecal coliforms and *E. coli*.

Buckland emphasizes that agricultural practices that may contribute to impaired water quality, will also be identified in conjunction with detailed land use, flow measurement and water quality monitoring. Best management practices that could be used to mitigate water quality problems will be identified and extended to local producers. For more information, please contact Gary Buckland, Irrigation Branch, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Lethbridge, Alberta, Canada T1J 4C7. Telephone (403) 381-5882. ■

The key result of this study is to maintain or improve surface water quality in the Crowfoot Creek watershed.

THE WATER HAULER'S BULLETIN

Designed to provide the operation and management personnel of Irrigation Districts with items of interest in their line of work. Comments are welcome. Please contact Duncan Lloyd, editor, at Area Code (403) 381-5539, Lethbridge.

View the Water Hauler's Bulletin on Internet web site:

http://www.agric.gov.ab.ca/irrigate/hauler/index.html

Published quarterly by the Irrigation Branch, Irrigation and Resource Management Division, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Lethbridge, Alberta, Canada T1J 4C7.

Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT