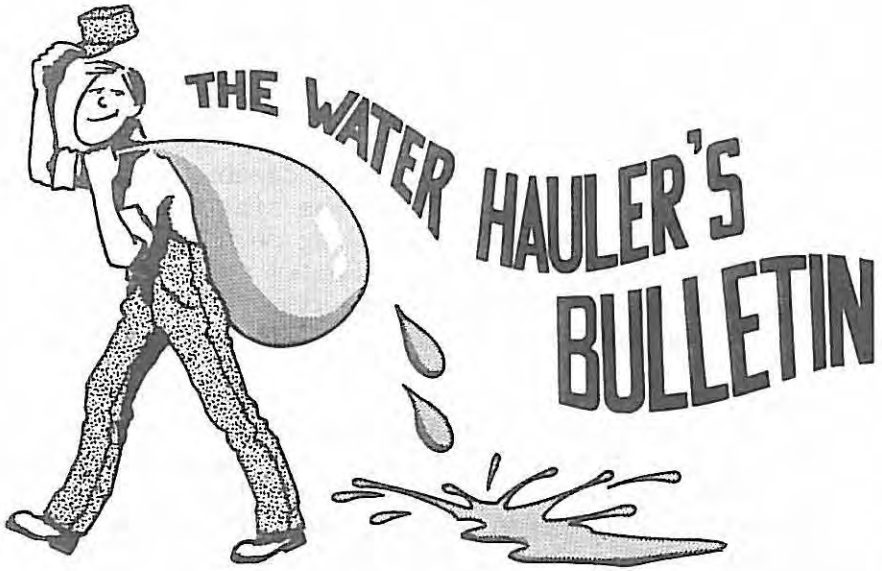

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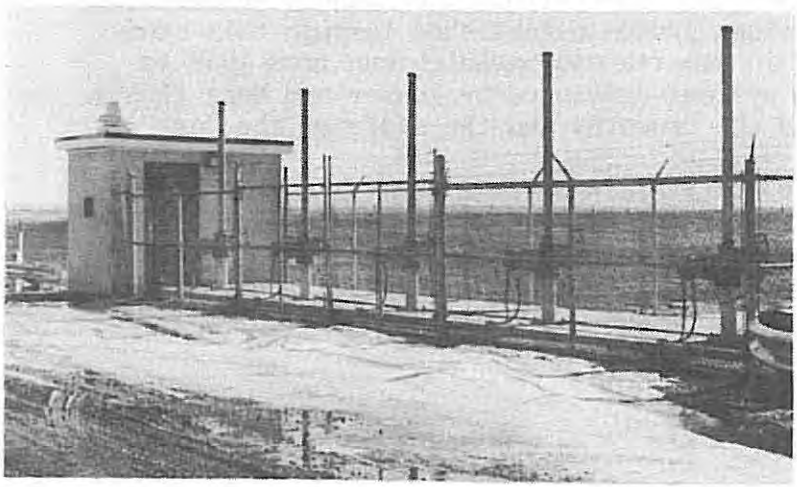
AUTOMATIC CONTROL SYSTEM FOR THE NEW STAFFORD RESERVOIR EXTENSION

A new concept in irrigation water control, designed by Underwood McLellan Ltd. of Lethbridge, was brought into operation by the St. Mary River Irrigation District in the spring of 1981.

The Stafford Dam Extension project included the construction of a dam and a control structure with an automatic control system, resulting in a 4 km extension of the existing Stafford Reservoir. The dam structure is a compacted earth embankment 1100 m long, with a maximum height of 7 m. The Stafford Reservoir, including the new extension, has a total live storage volume of approximately 18.5 x 10^6 m^3 (15,000 acre feet).



Canal operation is based upon a monitoring system which relays canal level information to the Modicon programmable gate controller. The controller compares the actual canal level to the preset level and opens or closes the gates to maintain the desired canal level. The gates operate in tandem, to provide even flow through the outlet. If the flow requirements become reduced to the point where five gates are not necessary, the system will select fewer gates.

A SLC II Supervisory System integrated into the control system is designed to allow the "ditch rider" to control the canal level remotely via a "special touch tone coding system". This SLC II System monitors the gate controller and provides remote control capabilities to the system. Basically, the ditch rider can telephone the station and the SLC II will provide information over the phone regarding downstream canal levels and gate positions. The SLC II Supervisory System computer is capable of speaking with a synthesized voice and can also communicate with other computers over the telephone.

When an abnormal operating condition occurs (i.e., canal level changing too rapidly), SLC II will automatically alert the ditch rider through the telephone system. As many as 16 different phone numbers can be programmed into the SLC II as numbers to be dialed during an alert response. The SLC II will begin dialing the first phone number on its program and if no answer, it will dial the second and so on, until it reaches and informs someone of the alert condition.

The SLC II is also in charge of security for the dam site. This computer is capable of informing the ditch operator and/or police, by telephone, that an unauthorized intruder has entered the station building.

With this supervisory system, the ditch riders can receive the canal level readings over the phone. Now, rather than driving to the same locations every day to read the canal levels, the ditch riders can use their time more effectively by inspecting other conditions.

* * *

ALBERTA LAND CLASSIFICATION

The evolution of land classification for irrigation in Alberta officially began in 1915 with the passing of the Irrigation Districts Act. Early classification systems gave little consideration to the properties of soil and substrata. Land selection was based on the ability to deliver water to the parcels proposed for irrigation.

As more became known about the soils of southern Alberta, land classification based on soil characteristics began to play more of a role in project planning. The first soil survey for irrigation was published by Wyatt and Ward in 1930 and involved lands within the Lethbridge Northern Irrigation District. The ratings system established through this study was used on similar projects in Alberta and Saskatchewan from 1930 to 1949. Later, classification systems developed by Bowser and Moss (1950) and P.F.R.A. (1960) reflected the concerns and the state of the "art" at the time.

Land classification for water rights became a legal requirement subsequent to the passing of the Irrigation Act in 1968. The "Alberta Standards for Irrigated Land Classification" were approved by Irrigation Council under the Irrigation Act in 1969. These "Standards" have been employed in the classification process since then.

Apart from being a legal requirement for water rights, the land classification process is designed to assess the potential value of lands for irrigation in order to aid and enhance project development, project management and long term productivity of the land. To carry out these functions various principles or factors are considered.

The principle of prediction identifies the need to assess the land-water-crop interactions expected to prevail after project development, or in the case of existing projects experiencing difficulty, after rehabilitation or reclamation works have been implemented. The principle recognizes that irrigation shifts the natural balance established over time between land, water, vegetation, fauna and man. Soil structure may be modified by physical and chemical processes. Important chemical changes may occur in the composition and concentration of dissolved constituents in the soil solution. Microrelief and characteristics of the soil profile can be altered by landforming, stone and brush removal, provisions for drainage, subsidence due to irrigation and increased erosion due to irrigation.

The land classification process recognizes that for each setting there are land features and characteristics which will not or cannot be changed under irrigation and those which can be, will be, or must be changed. Many land factors including soil depth, parent material, texture and topography are changeable at a cost but within the realm of physical or economic feasibility may be considered permanent. On the other hand, many factors are changeable or may require change prior to irrigation development. Soil salinity, sodicity, stoniness, drainage regime, minor irregularities in relief, brush and tree cover are typical changeable factors.

Don Norrie at work describing a soil profile on the deck of his B-31 mobile drill unit.

The distinction between various classes of land is made through consideration of significant permanent and changeable factors. These factors can be further exemplified by identification of the general conditions required for profitable diversified crop production under sustained irrigation. These general conditions can be described as follows:

1. The soil should have adequate moisture holding capacity for the proposed method of irrigation and cropping pattern.

2. There should be adequate soil internal drainage through the root zone to permit proper aeration, replenishment of soil-water reservoirs, and leaching of soluble salts.

3. Soil infiltration rates should be sufficient to facilitate replenishment of soil moisture lost through evapotranspiration and minimize erosion but slow enough to prevent excessive deep percolation under the irrigation method proposed.

4. There should be sufficient depth of suitable material to allow necessary root development and provide adequate storage of moisture and plant nutrients.

5. Soil texture, structure and consistency must permit necessary and timely field operations.

6. The soil must be free from injurious amounts of salinity or sodicity (if present, correctable at permissible cost).

7. Subsurface drainability must be adequate to allow for leaching of salts and aeration of the root zone under natural conditions or could be supplied at a reasonable cost.

8. The soil must be amendable to an adequate supply of plant nutrients, have a favorable cation exchange capacity and be free from injurious amounts of toxic elements.

9. The topography must have attributes of degree of slope and relief suitable for irrigation development with current technology and at a reasonable cost.

The application of basic principles and assessment of the above conditions is the land classification process. Last year, the professional and technical staff of the Land Classification Branch completed classification reports for nearly five hundred parcels of land (79,200 acres) under the Land Classification for Water Rights Program. The Land Classification Branch was also responsible for land classification work involving approximately 676,870 acres of land under the Irrigation District Systems Improvement and Irrigation Feasibility and Development Planning Programs. The projects completed by our professional and technical staff under these two programs included Level III Land Classification of the Magrath Irrigation District (81,290 acres), the Turin Block - LNID (9,760 acres), the Albion Block - LNID (48,500 acres), the Monarch-Piyami Block (12,800 acres), South Horsefly - SMRID (3,400 acres), Block 4a - WID (69,000 acres), Block 5 - WID (82,000 acres), the North Raymond Pipeline Project (4,800 acres) and Block 7a - EID (10,600 acres). Level III projects completed by consultants and supervised by the professional and managerial staff of our Branch included the Main Canal Block - LNID (48,000 acres), Block 6a - Rosemary - EID (23,000 acres), the Sheerness Pipeline Project (29,960 acres), the Deadfish Creek Project (41,160 acres), the Peigan Indian Reserve (94,000 acres), North Burdett, North Grassy, East Burdett and Bow Island Tracts - SMRID (57,600 acres) and the Blood Indian Reserve (61,000 acres).

To date this year, landowners have submitted requests through their irrigation districts for water rights on 506 parcels of land (approximately 80,960 acres). Reports on these parcels will require field investigation and completion prior to December 10, 1982. In addition, several Level III projects are on tap for this year. Level III work is to be completed by our staff on the entire Raymond Irrigation District (160,000 acres), Block 4b - Langdon-Eagle Lake area - WID (183,000 acres), Lyalta Block - WID (86,000 acres), small blocks in the TID (16,000 acres) and the Whoop-Up Lateral - SMRID (4,800 acres). Consultants are expected to complete land classification work on Blocks 6b, 6c and 6d in the EID (143,100 acres) by August 31, 1982. Blocks 4a and 4b - EID (115,400 acres) are also to be done by consultants with a completion date of December 31, 1982.

The workload over the past few years has increased considerably. This trend is expected to continue until the fall of 1985. Our commitments under the Irrigation District Systems Improvement Program will be completed at that time. In addition, as more on-stream water storage becomes available, more permanent water rights will be issued by the Irrigation Districts. These rights will require supporting land classification information.

* * *

FLEXIBLE GROUTING MATERIALS

Repairs of cracked hydraulic structures often involves the use of pressure injected grouts. Neat cement, sand cement and epoxy based products are most often used.

Repairs of the Chin Dam conduit cracks presented a more difficult problem for Underwood McLellan Ltd. in that the conduits are still settling at a rate of 6 mm per year. The existing cracks are still enlarging and any rigid grout would only be effective for a short period of time.

(continued on next page)

Flexible DECI 162 grout being injected into crack in Chin conduit.

Thyssen Mining Construction of Canada Ltd. (TMCC) proposed the use of flexible grouting materials, namely DECI 16 and DECI 162. Both are one part chemicals which react with water. DECI 16 generates gas in reaction and in an unconfined condition expands about eight times to form a semi-rigid foam. This material has low viscosity and penetrates cracks very well. DECI 162 expands very little on reaction, bonds extremely well to wet concrete, is highly elastic, but has higher viscosity and is more difficult to inject into hairline cracks. Both these materials are being used in the repairs at Chin. DECI 162 has been used to seal the large cracks in the conduits (up to 60 mm wide) and DECI 16 has been injected into the hairline conduit cracks.

Technical information and applications information is available from: Denca Construction Specialities Inc., Edmonton, Alberta. As more information is gained through monitoring the materials, we will endeavor to keep our readers posted.

* * *

THE PLOUGH METHOD DRAWS GROWING INTEREST

The "Plough Method" appropriately named has greatly simplified installation and reduced construction costs from the traditional open trench method of installing vertical cutoff curtains to control canal seepage.

Briefly, the plough method or "trenchless method" entails feeding the plastic curtain through a chute or plough which is pulled through the soil by a large crawler tractor. No backfilling of the trench is required as the soil collapses back against the curtain.

The Western Irrigation District contracted ECOS Engineering Services Ltd. and C. W. Farmland Reclamation Ltd. to design and install the cutoff curtain by the new plough method. Dupont of Canada Ltd. through Calgary Tent & Awning Ltd. supplied two types of Fabrene (P and TP grades) and the Contractor supplied Griffolyn.

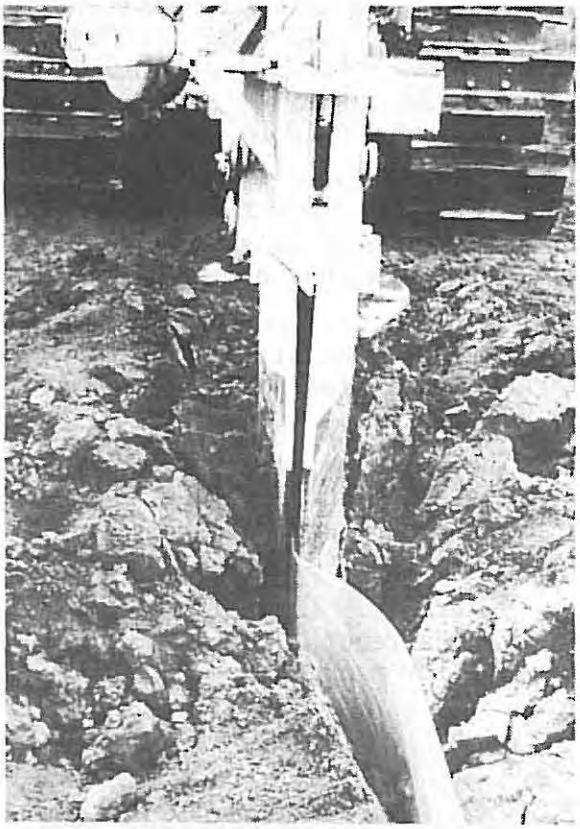
The Contractor's equipment was limited to a maximum depth of 2.4 m, so it was decided to regrade the ditch bank and lower it to a height of 150 mm above the full supply level of the lateral. This allowed a lower elevation to be achieved, provided a wider base for the Contractor's equipment and eliminated the need for laser equipment to control the depth of the plough.

Initially there was concern as to whether a membrane liner would tear or puncture under such installation procedures. Thus, the District had several inspection pits dug along the length of the installation. The liner was found to be generally installed to grade, and there were no signs of puncture or tearing.

The advantages recognized by the District and ECOS Engineering of this plough method are: possible trench collapse is avoided; minimal disturbance to the canal bank; less width of liner material required; manpower is reduced; and it is feasible to install the liner while the lateral is in use. The only disadvantage noted for this type of construction was the limitation on the depth the plough could be inserted and pulled.

Alberta Agriculture has installed piezometers at the site to determine the effectiveness of the cutoff curtain and will continue to monitor the project.

Traditional
Open Trench Method



Plough Method

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UPDATE ON CONCRETE CANAL CRACK INVENTORY

The Evaluation & Management Section of the Project Planning Branch will not be making a complete cracking survey of all concrete lined laterals in the spring of 1982. A complete inventory is proposed to be done again in the spring of 1983. However, the Section will inventory all reinforced wire mesh sections and make "spot-checks" in all the Districts where concrete lining is installed. Results will be published in the summer issue.

* * *

NEW WATERPROOF JOINT

With the recent acquisition of sophisticated heat-sealing equipment, Calgary Tent and Awning Ltd. is now fabricating ditch liners with water-tight seams.

According to Barry Fawcett, Sales Manager, the new Calgary tent equipment is unique in the Province in its versatility in seaming fabrics of varying weights, its speed and the quality of seam it produces.

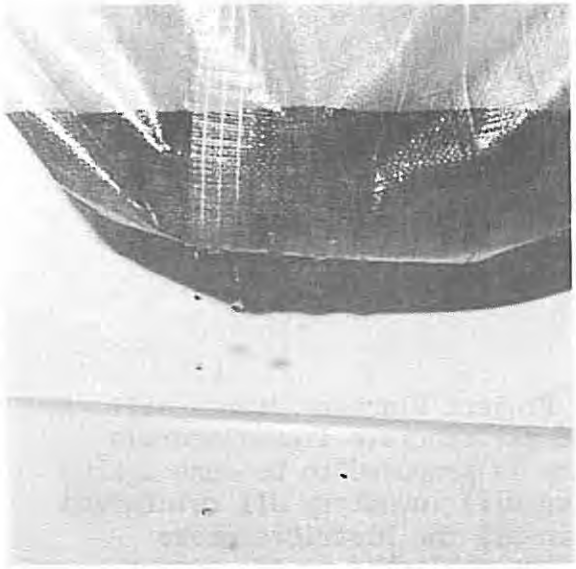
"It is the only machine in Alberta sophisticated enough to heat-seal the light weight polys as well as the vinyl heavyweights. While most of us in the business have been heat-sealing the vinyls for some years, we could not fine tune the temperatures with the old equipment to seal the lighter woven polyolefins such as "Fabrene". This is being increasingly used as lining material for irrigation ditches, dugouts, ponds, and lagoons", said Fawcett.

The new sealer is designed to remain stationary or can be set on tracks to travel along the material to be joined. "For something like ditch liners where we are joining 250 foot widths of material, we have better control with the machine in the stationary mode", said Fawcett.

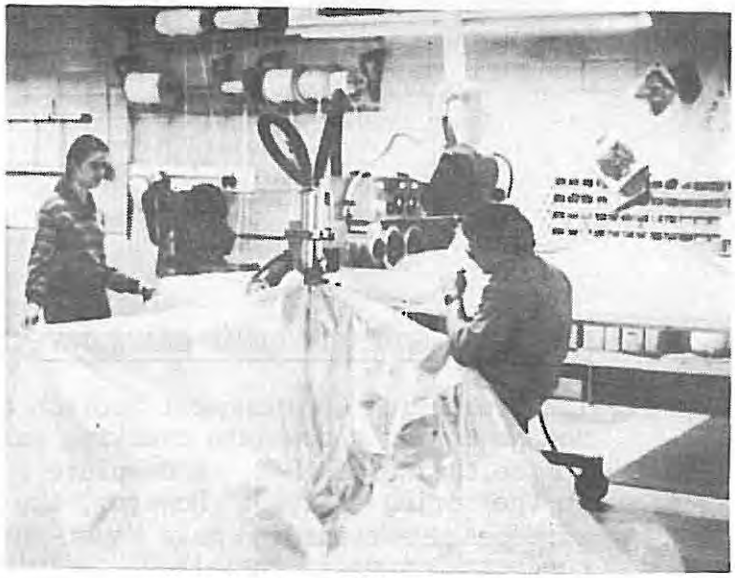
Two jets of super heated air are forced on to the fabric surfaces to be joined. The air temperature to each surface can be controlled separately. As the surface coatings melt they are pressed between two rollers and fused into a strong, water impermeable seam.

The operator's control over the fabrics being joined is demonstrated by the attached sample. Two different weights of Dupont's two-side-coated "Fabrene", woven polyolefin fabric is heat-sealed into a permanent seam.

The lighter fabric is TPNN "Fabrene" and the heavier orange sample is TE "Fabrene". These fabrics and their one-side-coated equivalents, P and TM "Fabrene", are gaining popularity as ditch and pond lining materials and for many other agricultural applications (see sample).



Old method of joining Fabrene by overlapping and stitching. Note leaks.



New heat sealing process for watertight seams on Fabrene.

* * *

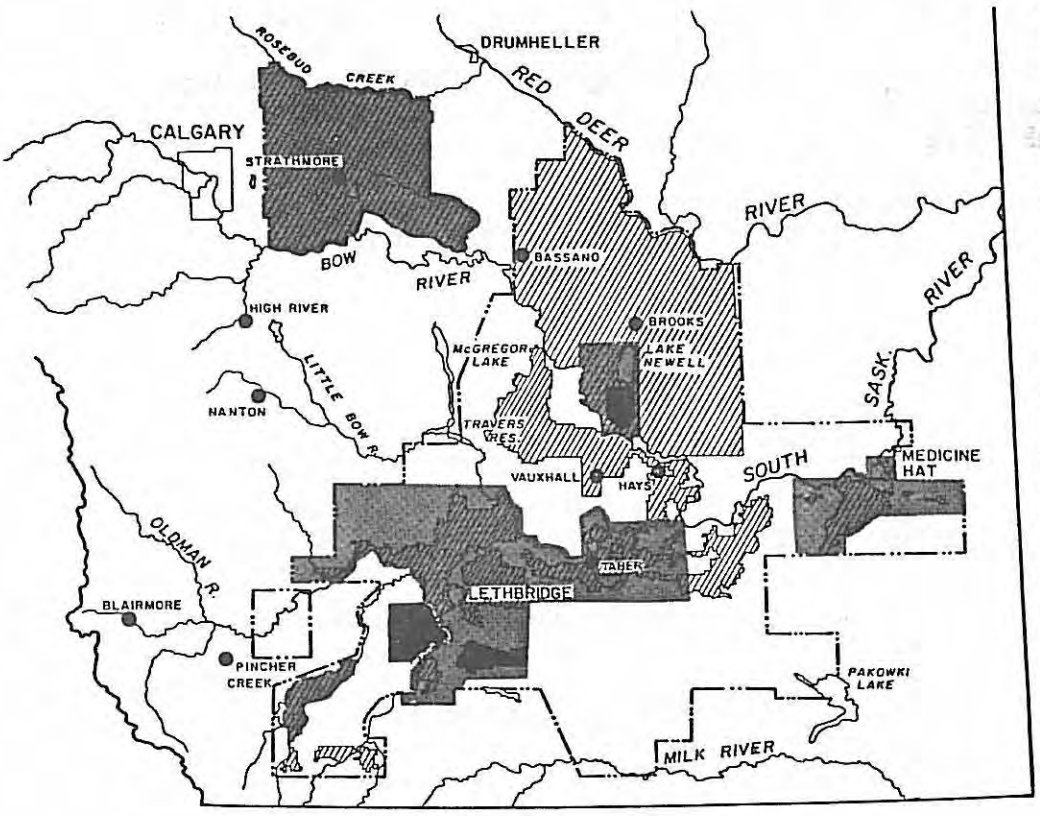
NEWS FROM THE AERIAL PHOTO MAPPING PROGRAM

In June of last year, an article was prepared, for this bulletin, outlining the processes and status of this photo-topography inventory program being carried out by the Irrigation Division of Alberta Agriculture. Having explained the operations and purpose of the program, it may now be useful to know of the status of various segments of the program and what information is now available. A short summary follows.

All photography and ground control surveying is completed. Work is presently underway, and will continue through the summer, on installing the bench mark identification plaques on the associated marker posts throughout the project area. A continual inventory and updating of these bench marks will be maintained. Should anyone determine that one of these has been disturbed, destroyed, or is required to be relocated due to proposed construction in the site area, he is asked to immediately contact Mr. Frank Gross, Irrigation Division, Lethbridge, at 329-5164.

The coverage of several irrigation districts has been aerial-triangulated with the adjusted data now stored in the data bank. This means that any user can, as required, have topographic maps, profiles, etc. prepared at his own expense. The areas data-banked to date include the following irrigation districts: United, Raymond, Magrath, Lethbridge Northern, St. Mary (West and East Blocks), Ross Creek, Taber, Western and the Kitsim Block of the Eastern Irrigation District. (See Map.)

Some mapping has already been prepared, as required in recent development projects, covering all of the Raymond Irrigation District, a portion of the Kitsim Block and 10-20 sections scattered throughout the program area.



PROJECT AREA BOUNDARY
IRRIGATION DISTRICTS
DATA BANK
CONTOUR MAPS

MAP OF SOUTHERN ALBERTA SHOWING AERIAL PHOTOGRAPHY MAPPING PROGRAM

One particular addition to the originally proposed program, which has recently been totally completed, provides photography, data-banking and mapping of the Big Lease Area of the Blood Indian Reserve, in its entirety.

Yet to be data-banked are: the remainder of the Eastern Irrigation District and Mountain Irrigation Districts, the Bow River and St. Mary (Central Block) Irrigation District, as well as, Lethbridge S.E. and High-line project areas. This work will be completed over the next two years, with the presently irrigated areas being data-banked first.

There is one other related program, now reaching completion, which is being sponsored by the irrigation districts of Southern Alberta, in cooperation with the Irrigation Division and Alberta Energy and Natural Resources, funding being provided from the I.C.W. allotment. This program is providing photographic base map coverage, on a township format, of all presently and potentially irrigated lands within the irrigation districts. This will involve an area of some 260 townships. The photo coverage is at a scale of 1:60,000. However, 1:20,000 scale orthophotos are being prepared therefrom to be used directly or further enlarged in scale as required. As a simplified explanation, orthophotos are simply photographic reproductions which have been mathematically and electronically corrected for exact scale and zero distortion or displacement, which normally does occur in conventional photography to some degree. These scaled photo base maps will not only be useful for district planning purposes but also will serve as a complimentary update to the four or five year old mapping program photography. This latest photography was virtually completed in fall of 1981 and the orthophotos should be available in June of this year.

For further information on any aspect of the above programs, contact Mr. A. L. Potvin, Project Planning Branch, Irrigation Division, Lethbridge, at 329-5170.

* * *

RIGHT OF WAY AND APPRAISAL SERVICES AVAILABLE TO IRRIGATION DISTRICTS

The Evaluation & Management Section of the Project Planning Branch has available to the Irrigation Districts a Right of Way and Appraisal Service. Assistance will be provided to any District in the following areas:

- preparing plans for areas required for irrigation easements
- preparing and executing of the necessary legal documents for registration in the Land Titles Office
- drawing up transfers for right of way requirements
- in the inspection and the negotiation of right of way and easement purchases
- evaluating the amount due in the case of compensation for right of way purchases

For assistance or further information call Ernest Frache at 329-5164.

* * *

MAXIMUM DEPTHS FOR PLASTIC DRAIN TILE

The Drainage Branch of the Department of Agriculture has received an increasing number of inquiries as to maximum depth and installation limitations that may apply to corrugated plastic drainage tile. In general, the same installation precautions that apply to normal depth corrugated plastic tile also apply to deeply placed tile with some additional considerations.

Therefore, whether at normal depth or deeply placed the tile must be: bedded in a machine formed groove; "blinded" under the sides with well granulated material; and protected with a soil cover prior to back-filling. Trench width must also be compatible with tile diameter to allow bedding material to roll under the sides. In wide trench excavation blinding material must be compacted.

Recently, the results of four years of experimentation using several different depth placements and sizes of tile were evaluated and reported by R. S. Broughton[1] and others of McGill University. A summary of the main aspects of the study is included here.

The study involved installing heavy duty corrugated plastic tile at depths of up to 9 m. In preparation, the upper 8.2 m of overburden were first removed from the test site. Then several 100 mm and 200 mm tiles were installed by trencher to an additional 0.75 m of depth. All other tile were bedded in a 90° groove on compacted crushed stone at the 8.2 m depth of cut and were then blinded with compacted crushed stone prior to general backfilling.

The results of the study seem to show that a maximum deflection of the inside diameter of 20% can apparently be tolerated before pipe failure is likely. However:

> "If one takes the conservative view that tubing would be safer if the deflection were less than 18% of the inside diameter... the (3 and 4 inch polyethylene)... tubes would be good for fills less than 6 feet high; the 6 and 8 inch PE tubes would be good for fills up to 27 feet high; and the 10 and 12 inch tubes would be good for fills up to 16 feet high."

Specific recommendations made in the report are as follows:

1. If corrugated plastic drainage tile is to be installed deeper than 2 m, care should be taken to provide good bedding and backfill with sand, or crumbly, stone-free soil.
2. Compact the backfill at the sides of the tile.
3. Use heavy duty tile.
4. Do not install 75 mm or 100 mm corrugated plastic drainage tile deeper than 2 m unless it is placed in a narrow trench before the fill overburden is added.

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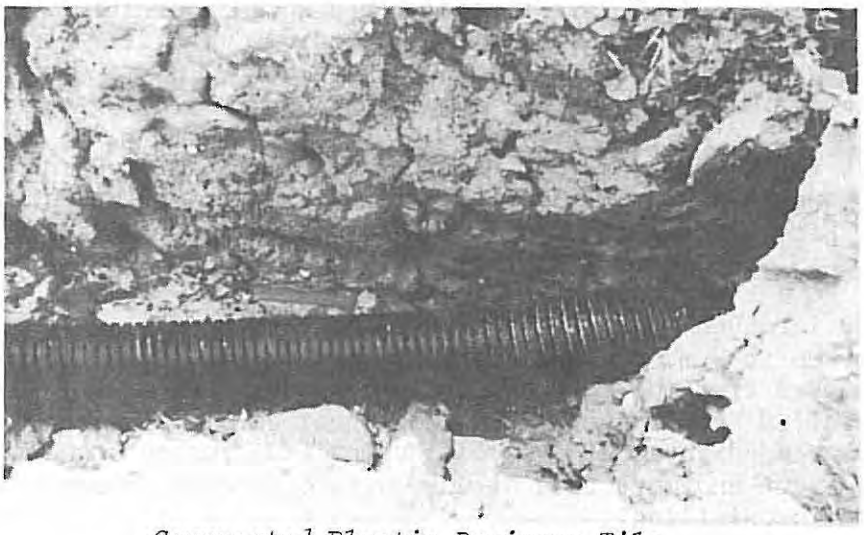
1. R. S. Broughton, C. F. Bolduc and S. R. Ami (1981). Observations on the deep earth loading of corrugated plastic tubing. Presented at the Annual Meeting of the Corrugated Plastic Tubing Association, Fort Lauderdale, Florida, USA.

Finally, it should be noted that the report suggests some past and future tile failures within the study may be due to stress concentration caused by sharp corners from the crushed stone. Further investigation is indicated.

Those requiring additional information on maximum corrugated plastic drainage tile depths can contact Brook Harker of the Drainage Branch (329-5159) or refer directly to the paper by Broughton.



Corrugated Plastic Drainage Tile in trench before backfilling.

* * *

The Project Planning Branch would like to take this opportunity to express their appreciation and thanks to Roger Knibbs for his work and involvement in past issues of The Water Hauler's Bulletin. As many of you know, Roger has taken a new position with Alberta Environment and will no longer be involved in producing the bulletin.

* * *

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 E. D. Lloyd at 329-5164, Lethbridge.

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