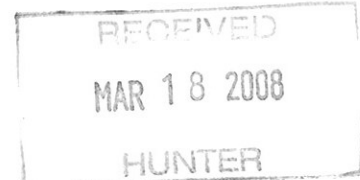


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**Mr. Garry T. Hunter, M.A.Sc., P.Eng.,**  
**President, Hunter and Associates,**  
2285 Dunwin drive, Unit 18,  
Mississauga, ON L6L 3S3

2008-03-14

**Re: Review of Background Report and Design Guide  
Conservation (Controlled) Drainage and Subirrigation Project  
(CDSI) Southern Ontario**

**Dear Mr. Hunter:**

I respond to your request that I review the Background Report and Design Guide on CDSI that you and your colleagues have prepared. I regret that due to other commitments I could not complete this review sooner.

Congratulations to you and your associates for the good work that you have done creating this Background Report and Design Guide. You have obtained pertinent information from a large number of publications. You have described the relevant concepts in easily readable language. You have made very good diagrams to illustrate the concepts.

I have found very few typographic errors. I will indicate my questions, discussion and suggestions by page number.

**Page 3.** I suggest that you include a definition of “depth of drain”. It would probably be a good thing to use the same definition as in page 27 of the new OMAFRA Drainage Guide, where depth of drain is given as the depth to the bottom of the pipe.

**Item 1.1.8 “Crop Water Deficit”.** Perhaps it would be good to add the phrase “during the growing season if the crop under consideration” after the word “evapotranspiration” in line 2.

**Item 1.1.9 “Depth to Impermeable Layer”** third line perhaps replace the words “only about” with the words “less than”. In many situations the “impermeable layer” has a vertical conductivity considerably less than 10% of the vertical conductivity of the surface layer.

**Page 5. Item 1.1.16** Perhaps extend the title to be “**No Tillage and Minimum Tillage**” Some minor changes might be made in the 2 paragraphs to encompass minimum tillage. In many situations of so called “no-tillage” there is in fact a small amount of tillage to prepare a narrow band into which the seeds are placed. Also, many clay soils require plowing or tine cultivation at least once-in-3-years. So for clay soils it is possible to speak of “minimum tillage, but not “no-tillage”

**Page 26, Item 2.2.3 third line**, I think that it helps the clarity to hyphenate “on-farm” in sentences such as this.

**Page 34.** I have trouble visualizing saturated hydraulic conductivities in cm/sec. I like to work in cm/hour, or cm/day, or m/day for hydrology, infiltration or drainage situations. I got the impression at the LICO conference that other persons also had no feel for hydraulic conductivities in cm/sec. In soil mechanics literature and perhaps soil physics literature the cm/sec units are used. Perhaps it would be good to provide conversions somewhere in the Report.  $1\text{m/day} = 100\text{cm/day} = 0.0012\text{ cm/sec} = 1.2 \times 10^{-3}\text{ cm/sec}$ . Or,  $1 \times 10^{-5}\text{ cm/sec} = 0.86\text{ cm/day}$

**Item 2.4.2** From my experience neither drainage nor subirrigation works well if the horizontal saturated hydraulic conductivity is less than about 0.16 m/day (or  $2 \times 10^{-4}\text{ cm/sec}$ ), so I will be surprised if CDSI works very well at the Defiance County site.

**Page 35. Item 2.4.4 Van Wert County site.** CDSI should work OK here the saturated horizontal hydraulic conductivity is between  $2 \times 10^{-4}$  and  $4 \times 10^{-4}\text{ cm/sec}$  that is between 0.16 and 0.32 m/day.

**Chapter 3 is very well written.** The author and internal reviewers write very good English. The print size for the descriptive words on the figures needs to be larger in the final report.

**Chapter 4** is also very well written with all the important points covered. I suggest that you consider adding the suggestion that solar powered pumps

may be used at sites where the pump is far removed from the electric grid. I used a solar powered pump to good advantage at one of my subsurface irrigation sites 16 to 18 years ago. When the sun is shining the evapotranspiration and the solar power for pumps are both high. A direct drive DC motor pump will do the job. I bought the items from an Ag engineer in Alberta who was using solar powered pumps for pumping water for cattle and also for drainage for salinity control. The heads he was using were similar to those for subirrigation.

**Item 4.1.7 Detailed Soil Maps.** Is anyone in Ontario making the detailed site specific soil maps to which you refer? Are there consulting soil surveyors available to do this work?

It might be good to include a diagram of a PVC water table observation well; some description of how to install them, and a diagram of at least 2 types of measuring device that a farmer can use to measure the depth to the water table. Innotag Inc. in Quebec manufactures slotted PVC pipes with a sock or geo-textile covering. They also manufacture a measuring device that one inserts into the well. It beeps when it touches the water. I can also get diagrams and details of devices currently being used by some other persons.

**Page 54. A comment re paragraph 3 and shallow muck soils.** If farmers wish to try to grow economic crops on muck soils shallower than 500mm that are underlain by stone-free sand silt or clay, the good management practice is to raise some mineral soil to the surface, let it weather on the surface for a few months then mix it in with the organic soil. This will reduce the oxidation of the organic soil and increase its life. The area can be farmed as a mineral soil with high organic content, rather than as an organic soil. There is often a thin layer at the interface between the organic and mineral soils that discourages roots from moving into the mineral soil from the organic soil. Deep tines that rip through this layer and bring some mineral soil to the surface can be used to help keep these soils producing food or fodder. Producing hay crops in the rotation also increase the life of these soils. I had the pleasure in September 1971 to observe subsoil raising that Dr. Ansley Ede and some farmers were doing in the fenlands north of Cambridge England. They had made a heavy steel blade about 350mm wide that was slanted back at an angle of about 30 degrees above the horizontal with depth adjustable to about 600mm, and a side slope or twist at the top to direct the raised subsoil to fall to one side. They pulled this with a small crawler tractor, the size of a D2 Caterpillar. They made one pass of this

machine at about 5-foot spacings. The subsoil was left on the surface to weather over winter. When field conditions were dry enough the next May or June the raised subsoil and the organic topsoil were mixed with discs, or other tillage machines, and a crop was planted. The following year, or later, the subsoil raising machine was used in a direction perpendicular, or diagonal, to the first usage, and so over an interval of 5 years or more a drainable long lasting high organic content mineral soil was created. We have done something similar at the Macdonald Campus farm with deep plowing, or sub-soiling tools. A small number of large single furrow plows exist in Quebec for this kind of work.

**Page 55. The drain spacings** suggested are closer than any of my experience. Perhaps it would be good to put in a table listing some of the “specialty crops” and the “cash crops”.

**Page 56 Section 4.6, third paragraph:** Perhaps the following sentence could be added. “Solar powered pumps may be a possibility for locations far removed from electric power lines.”

**Page 58. fourth paragraph,** first line: replace the put an “o” in the word drought.

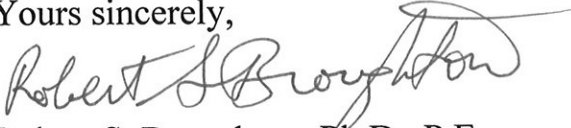
### **SOME POSSIBLE ADDITIONAL INFORMATION ON FARMERS’ EXPERIENCE WITH MANAGING CDSI SYSTEMS.**

You pointed out at the LICO meeting there is a need for more information on the use and management of CDSI systems on areas of tens of hectares.

I have talked with Robert Maloin, former president of INNOTAG Inc. He has installed CDSI systems on many farms in south western Quebec since 1985. He is willing to make appointments for enquiry visits with farmers who have many hectares with CDSI. Some have sizable ponds that they fill in April by pumping from drainage watercourses. I will try to prepare a questionnaire for you to review with me. Then I will try to arrange a trip this coming summer at a time convenient to Robert Maloin and some farmers to visit and get answers to our questionnaire to help provide more information on farms with significant areas under CDSI. There may be farms in Ontario

to be visited for similar information. Perhaps some LICO members could identify farmers to be contacted.

Yours sincerely,

A handwritten signature in cursive script, reading "Robert S. Broughton". The signature is written in black ink and is positioned above the printed name.

Robert S. Broughton, Ph.D., P.Eng.

Consultant in Soil, Water and Environmental Engineering.

Cc John Johnston