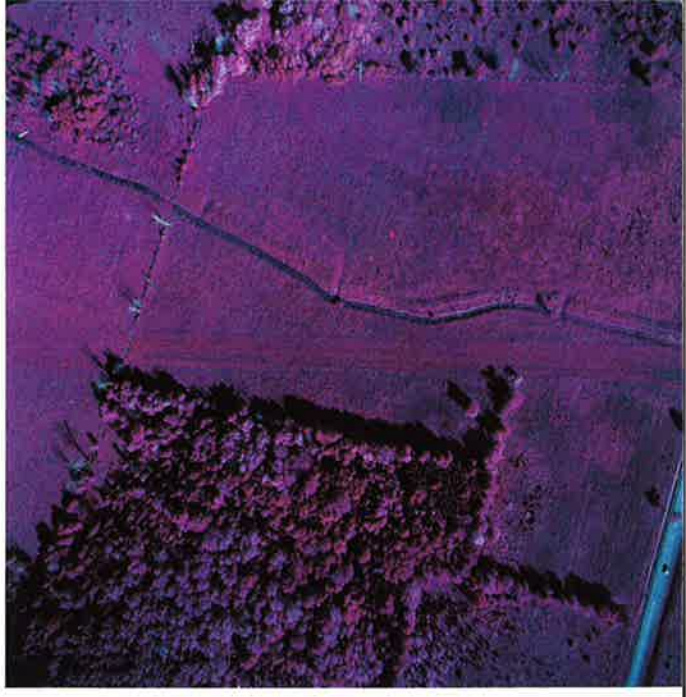
To What Extent Is Topsoil Conservation Necessary In Pipelining?

by S. Alex Ramsay



Many a landsman, while acquiring right of way for pipeline construction, has guaranteed the landowner that his land will be restored as closely as possible to its pre-construction state. The question of topsoil separation and replacement may have arisen during preliminary discussions, but more likely this subject has been left until just prior to construction when the company inspector and landowner have agreed on a practical width and depth of topsoil to be stripped from the right of way. This information is then relayed to the contractor. At this point, the landsman must depend on the contractor's appreciation of the local environment and the skill of individual bulldozer operators who carry out the work.

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Photo #13. An abandoned pasture in Glengarry County, Ontario. The right of way had a 3:1 vegetation increase, once rehabilitation was complete. Photo #5 was taken 1500 feet above ground level. The Inter Provincial Pipe Line easement is 60 feet wide and cuts through a hardwood woodlot and dormant field. The right of way was seeded by a contractor in 1977 to a mixture of bird's foot-trefoil and timothy with 400 lbs/acre of 10-20-20 fertilizer. Deeper color depicts a more active plant growth. Note the kidney shaped pond is south of the right of way which cuts across the gravel road to the east. The municipal drainage ditch is 1000 feet to the south.

There are a number of important items on the contractor's agenda besides topsoil conservation. He is primarily concerned with getting welded pipe into the ground as efficiently as possible. Topsoil separation and subsequent replacement may, in the bustle of construction activity, be given a low priority, and, if wet weather predominates during the construction period, topsoil may be buried or diluted with subsoil. If this happens it is certain that the landsman will hear about it and the company may have to pay for the contractor's lack of expertise in conserving topsoil. The landowner won't hesitate to voice his dissatisfaction through damage claims. In some cases long-term crop loss payments may result. What improvements can be made to add credibility to the guarantee of land restoration?

In the past, environmental assessment reports have only provided guidelines for agricultural lands; in the

future to be effective they should provide useful details which will contribute to better topsoil conservation.

Any environmental assessment of the region to be traversed should include detailed information on soils along the pipeline route. If topsoil ("the layer of soil moved in cultivation")* is to be separated, exact depths should be delineated for each field to be crossed and qualified inspectors put on the job to ensure that the work is carried out properly.

The preservation of agricultural land generally, and topsoil conservation specifically, has been traditionally left up to private landowners who may or may not have intimate knowledge of their land. The variable nature of soil requires that a detailed assessment of the atrributes of each field be undertaken. Where a longstanding appreciation for the soil has been developed by a well informed farmer, topsoil separation according to his suggestions will likely be satisfactory as long as the construction period is dry. Unfortunately, good weather and pipeline construction don't always go hand and hand. Restrictions on working in wet weather should be spelled-out in detail where soils are subject to damage.

An agreed upon width and depth of topsoil to be stripped, should be listed for each property. This detailed list should then be included as an appendix to the construction specifications so that the contractor knows the exact requirements of the job in advance.

Research on the impact of pipeline construction on soil productivity has been carried out across Canada. In Western Canada the negative impact of pipelining with no topsoil separation is apparently minimal. In fact, an improvement in crop growth for a number of soils has been found over pipelines and has been reported by Dejong and Button (1973) in Saskatchewan and, by Toogood (1974) in Alberta.

The greatest increase in growth was noted over the pipeline trench in Solonetzic soils on the Prairies. These soils are characterized by a very dense subsoil which prevents root penetration. Ditching effectively breaks up this hard pan allowing deeper rooting, and better soil moisture availability to plants.

Crop yield is the best measure of soil productivity, but it is not necessarily the whole story. Farmers are also concerned with maintaining a uniform friable seedbed. Subsoil which may be brought to the surface during pipelining may produce cloddy, undesirable soil aggregates which require extra tillage. This illustrates the need for a detailed site specific examination of topsoil separation, which involves communications with the landowners, and the development of measures which will enhance public relations.,

In Eastern Canada topsoil conservation seems more important. Recent studies showed that pipeline construction carried out under adverse working conditions resulted in mixing of topsoil and subsoil and significant short term crop losses. Dr. A. F. MacKenzie and the writer determined crop loss at a number of sites on right of way between Sarnia, Ontario and Montreal, Quebec two years after construction, and found that yields were reduced an average of 33% for the 91 fields monitored. This loss was attributed to a significant decrease in soil organic matter (humus) of the pipelined soil which was indicative of poor soil structure as well as a loss of fertility. Significant increases in soil pH (low pH=acidic, high pH=alkaline) on right of way were also found which was a further indication that mixing of topsoil sand subsoil had occurred. The results were confirmed by Culley et at (1981) four years after construction with smaller but significant yield depressions persisting over time at some locations.

A good contrast to these findings is provided by a study of agricultural land by Andre Marsan and Associes Inc., one-to-two years after winter construction of a gas pipeline in Quebec, where no topsoil stripping had been carried out. Construction under frozen conditions resulted in decreased

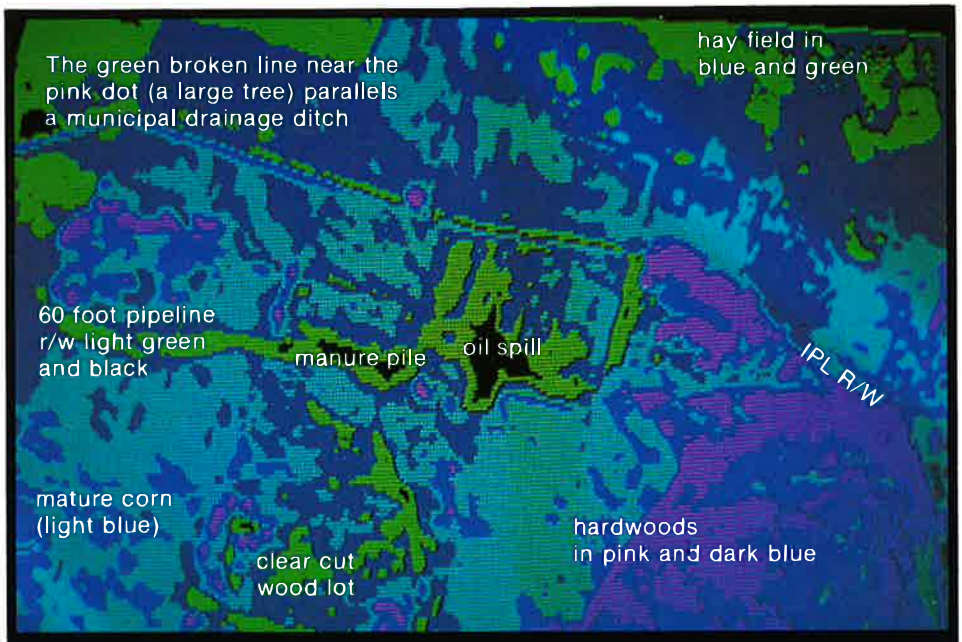
*Topsoil, as defined in Glossary of Terms in Soil Science, Agriculture Canada. Publication 1459, 1976.

organic matter levels and increased soil pH values on the narrow ditchline, but no significant differences on the working area of the right of way. Crop growth was reported to be equal on and off right of way for corn and worse for small grains. Soil pH was improved since agricultural soils in the part of the provinces studies are naturally acidic. Moderate mixing of topsoil and subsoil provided a "liming" effect which increased the soil pH to an almost ideal neutral level.

These studies illustrate the need for adapting pipelining techniques and treatment of soil to the region to be reversed.

Government guidelines on this subject are apparently scarce but there are in fact practical reports that provide some direction to industry. The Land Resource Research Institute of Agriculture Canada recently issued a report entitled, "Impacts of Installation of an Oil Pipeline on the Productivity of Ontario Crop Land". The authors concluded that: "Construction of pipelines should be undertaken on dry soils (June-September) or on soil frozen to a depth of 20 cm (8 inches), if deleterious impacts to agricultural land are to be avoided. Stripping of topsoil from the trench, but not the work areas may be beneficial in reducing adverse impacts".

Although these conclusions were based on data from Eastern Canada, which has a humid climate, their application may very well be appropriate elsewhere across the continent.



Thermal Scan of an Oil Spill Site

Assessment of pipeline right of way vegetation, oil spill site and surrounding area north of Lancaster, Ontario. Temperature ranges are represented by the different colours. This information was acquired by Canada Centre for Remote Sensing September 24, 1979, from 1500 feet above ground level using a thermal scanner. The colours represent the following temperature ranges.

Black = 20-22° C (68-72° F)
Green = 17-20° C (63-68° F)
Dark blue = 15-17° C (59-63° F)
Light blue = 12-15° C (54-59° F)

Soil reclamation following a major oil pipeline leak was monitored using a thermal scanner. The highest temperatures were found where the oil content in the soil was greatest and on a large manure pile nearby. This indicates that conditions were favourable for biodegradation of crude oil in the soil.

The spoil pile is shown between stockpiled topsoil and the open ditch. Note the narrow width required for this method of topsoil separation. This photo was included in a report titled, "A Preliminary Assessment of the Impact of 1980 Pipeline Construction on Crops and Soils Southeast of Edmonton, Alberta."

Guidelines on minimum reclamation standards have been issued for Crown Lands by Alberta Environment. They include the following details on conservation of topsoil which are relevant to pipeline construction.

All surface disturbances should be kept to a minimum, with appropriate measures taken to control wind and water erosion.

Topsoil, including the surface organic horizon of the soil profile, should be selectively removed from the disturbed areas and conserved for the reconstruction of the root zone.

Clearly, conservation means minimizing the disturbance of land and preserving what topsoil is most likely to

be lost. From personal experience I would suggest that this can best be accomplished in pipelining by separating topsoil from over the ditchline and from where spoil material is to be piled. Thus, the optimum width to be stripped is in the order of 6 metres (18 feet) for major pipelines. Of course this figure will vary with the size of the pipe to be installed and the amount of spoil to be excavated and may extend to 10 metres (33 feet) for large diameter pipe.

Separation of topsoil from a greater width unnecessarily increases the width of right of way required since stockpiling of soil from across a full 20 metre (66 foot) width can involve up to 6 cubic metres (8 cubic yards) of soil per linear metre (3.28 feet) of right of way.

Wind erosion, mixing of topsoil and subsoil, soil compaction, damming of natural drainage and ponding of water on the disturbed area may all be exacerbated by the removal of soil from across the entire right of way. In addition to these physical considerations, extensive topsoil removal prolongs the pipelining process, causes further inconvenience to landowners, extra costs, and the extra time required to handle the large volume of soil increases the likelihood that poor weather will be encountered which may additionally delay the project. Emphasis then, should be placed on carrying out an efficient topsoil conservation program on a manageable width of soil. Hay and pasture crops left in place will help bind the soil, preventing wind and water erosion. Topsoil left in place will absorb the impact of machine traffic, so that soil compaction is concentrated in the upper layers of soil, which will be cultivated during clean up operations. The impact of pipeline construction will be concentrated on a narrow width of land, the soil will be disturbed as little as possible, and the length of time taken to carry out installation kept to a minimum.

Regardless of whether or not soil mixing occurs, productivity will return in time with the right soil amendments. It is becoming increasingly important to document the restoration process so that landowners, arbitrators and government agencies have tangible evidence that land disturbed during pipeline construction will return to normal productivity over a period of several years. Where damage to the soil has taken place intensive restoration measures may be necessary. My experience has been that the incorporation of large quantities of manure into the soil is the best cure-all, but where it is not available, which more often than not is the case, the temporary growth of a legume-grass rotation provides a good substitute, once established. Where neither of these measures are practical, aerial application of commercial fertilizer can easily be undertaken. This method allows timely additions of soil nutrients after final clean up, where fences and poor working conditions may make conventional applications impractical.

Documentation of restored productivity where deemed necessary can easily be accomplished by gathering soil and crop data in the field. Crop height generally corresponds with yield, but accurate assessment must also involve the collection of plant material, close to the harvest date, from representative fields. One approach is to weigh clippings from either a minimum 2 metre (6.6 foot) length, (for row crops) or from a square metre area,(for forage and small grain crops) repeated for each field at four or more sites (replicates) along the right of way for each zone (ditchline, working side, off right of way). Determination of dry weight should be made for either a representative subsample or for all clippings. Soil samples should also be taken at each site and submitted to a soil testing laboratory for analysis of available nutrients and soil organic matter. Soil test results are useful in determining whether soil amendments are required where any crop deficiencies

Typical construction layout showing working side, ditch, spoil pile and windrowed topsoil. West of Hwy. 36. This photo was included in a report titled, "A Preliminary Assessment of the Impact of 1980 Pipeline Construction on Crops and Soils Southeast of Edmonton, Alberta."

exist. Restored right of way with full vegetative cover is best assessed first on the ground and then by aircraft. Aerial photography using a standard 35 mm camera with either colour film (for mature crops) or colour infra-red film (for immature crops) is optimal, and documents growth for the entire field where ground assessment has taken place.

Pipeline companies are now accepting the responsibility for implementing a careful program of topsoil conservation on prime agricultural land. Where significant crop reduction indicates that conservation measures are not entirely successful, curative work can be carried out to restore soil productivity.

One of the benefits of detailed planning and assessment of the impact of construction activities is that data is accumulated which may be useful in negotiating equitable settlements where excessive damage claims arise. This information also provides a valuable insight into the most appropirate construction techniques for future pipeline projects.

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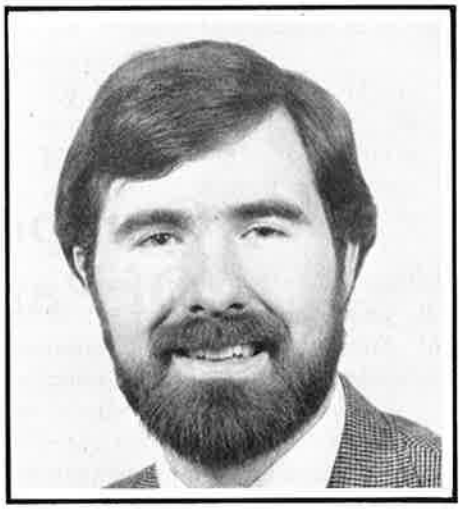

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