

A Review of the
Development Proposal for A Farrow-to-Finish
Hog Operation
By the Taiwan Sugar Corporation
In the County of Forty Mile,
Alberta, Canada

By Dr. William J. Weida
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Executive Summary

1. \$25-\$27 million in economic activity will be generated annually in the region according to claims by the Taiwan Sugar Corporation (TSC). The company also claims that the regional multiplier for the area is 2.87. Based on this figure, the company apparently plans to spend between \$8.7 million and \$9.4 million in the local area.¹ About \$7 million of this amount may be spent locally for feed.² The remaining direct economic impact would only be between \$1.7 and \$2.4 million, and about \$1.5 million of this is accounted for by the direct payroll associated with 54 jobs at the hog Intensive Livestock Operation (ILO). This leaves between \$200,000 and \$900,000 for all other direct spending in the region.
2. Since the motivation of an ILO such as the one proposed by the TSC is to create profit, not to control pollution or engage in any of the other social benefits the region may desire, the ILO can only be trusted to act in its own self interest. ILOs use laws based on loose, conventional agricultural standards to avoid pollution controls that would more fully assign the costs of waste to the ILOs. For example

The Taiwan Sugar Company settled on Alberta because "they felt most comfortable with the officials in government" ...government documents list Alberta's advantages for hog farmers as low grain costs, minimal taxes, abundant land and few rules. One document even promises investors that, "once established, there is no government involvement in the normal day-to-day operations of the farm," and that the province, "will remove as many regulations as possible."³

3. Cost shifting occurs when the costs of health problems, traffic, social problems and pollution (odors, chemical and particulate air pollution; chemical, pathogen, and particulate water pollution) are transferred to the residents of a region and are neither paid by the company responsible for the costs nor included in the price of the products they market. Not paying the costs of responsibly handling its pollution in Taiwan has led to increasing criticism so TSC is moving its operations to a location where not handling its pollution responsibly will lead to less criticism. It should be noted that TSC had a clear alternative it chose not to exercise--it could have simply absorbed the costs of responsibly handling its pollution and stayed in Taiwan. The likely reason TSC chose not to take this option is that it would have reduced its profits.
4. However ILOs are structured so that they cannot aid regional economic development for the following reasons:

(a) Constraints on Regional Economic Development Due To Employment

If the same increase in hog production levels proposed by the TSC were achieved simply by expanding the herd size on existing conventional hog farms, three times as much employment would be created in the region.

(b) Constraints on Regional Economic Development Due To Taxes

¹ DGH Engineering, Development Proposal for a Farrow-To-Finish Hog Operation by Taiwan Sugar Corporation, April, 2000, p. 56.

² Ibid.

³ Nikiforuk, Andrew, "The price of bringing home the bacon", Toronto Globe & Mail, June 12, 2000, p. 2.

The operations of the ILO create social, health and traffic costs that the local government must finance. The local government, in turn, must rely on increased taxes to pay these ILO-induced costs--and this can decrease other economic activity in the region.

(c) Constraints on Regional Economic Development Due To Vertical Integration

Vertical integration requires purchases from and sales to other members of the vertically integrated company, not from local producers and suppliers. Historically, this factor has severely limited the economic impact of ILOs on the regions in which they are situated.

Confined animal production can occasionally benefit local grain sellers, but only when it consumes all the grain produced in the region. If the region has to export even one bushel of grain, all the grain in the county will have to be priced at a lower level that will enable the grain to compete in the export market.⁴ When grain is priced at the export level the only beneficiary of purchasing locally is the hog ILO which saves on transportation costs.

(d) Constraints on Regional Economic Development Due To Cost Shifting

For reasons inherent in the structure of ILOs, most of the money from a ILO will either be directly spent outside the region or it will quickly migrate there. However, through cost shifting the ILO will leave the costs of its odor, health risks, surface water pollution, ground water pollution and in the long run, its abandoned lagoons and facilities for the region to deal with. This directly effects both long and short run economic development in the region.

5. TSC's proposal to inject hog waste directly into the ground to suppress odors is troubling. Injection nullifies efforts to expose hog waste to the air and to sunlight to destroy human pathogens, and the injected waste is likely to carry those pathogens into the soil and then into water that may be consumed by humans.
6. TSC employs the unrealistic assumption of continuous cropping in all of its nutrient use calculations. Even at the highest nutrient application rates, TSC would need about 50,000 spreadable acres for the nitrogen generated by the operation and about 80,000 acres for the phosphorus if the land is allowed to go fallow every other year. At the present time, TSC has not secured sufficient acreage to spread manure even with the promise that the manure will be free for the next ten years.
7. The sections in the TSC Proposal devoted to discussions of water show total annual water consumption that appears to be based solely on drinking water consumption. The water usage claimed in the proposal is far too low for a flush system even if the various assumptions and promises made by TSC in their proposal are taken into account. Likely total water use by TSC's proposed operation would range from about 420 million imperial gallons per year to about 375 million imperial gallons per year instead of the 45.4 million imperial gallons claimed in the TSC Proposal, and these figures do not account for the on-site mill and truck wash.

These usage rates could have a significant impact on water availability in the County of Forty Mile. Appendix G of the Proposal investigates areas of groundwater availability in a 4400 square kilometer region around the town of Bow Island. This is an extremely large area to draw water from if the usage at the proposed sites is really as small as TSC says it is.

⁴ Hayes, Dermot, Iowa's Pork Industry--Dollars and Scents, Iowa State University, January, 1998.

Introduction

The economic model that became capitalism is based on efficiencies from standardization, specialization and concentration of productive resources. As capitalism developed and this model was applied to production activities, social and environmental problems such as child labor, unhealthy working conditions, unfair labor practices, and polluting activities often occurred. Over time, these issues were dealt with in the industrial sector through a framework of laws and regulations.

Recently, agriculture has moved toward an industrial model of production--Intensive Livestock Operations (ILOs)--that exceeds the capacity of the land on which it is located to naturally process animal waste. In a fundamental sense, the ability of the land to naturally process animal waste defines the limits of sustainable agriculture. Agriculture can only be environmentally sustainable if it produces no more waste than the land available for waste application can absorb. Waste produced in excess of this amount must, at some point, be transferred off the land in the form of air- or water-borne pollution and when this occurs, the costs of this waste are shifted away from the land where the waste is generated.

Unfortunately, agriculture's shift to industrial ILOs outpaced laws and regulations governing agricultural activities--laws and regulations that were meant for a non-industrial sector. This occurred partly because agriculture is viewed by society in general through a lens colored by the assumption that the enterprise of agriculture is a "closed system" where the density of animals is compatible with the land's ability to recycle animal waste.

One central rationale of laws to regulate industrial waste was the recognition that the assumption of a closed system did not apply to industries. Industrial waste often polluted the environment of those who lived around (or many miles from) the industry and laws were necessary to prevent the harm to society that might come from contact with this pollution. The laws governing industrial waste forced industry and the consumers of its products to "internalize" (pay for) the costs of dealing with this pollution.

The assumption of a closed system is usually no more applicable to ILOs than it is to any other industrial operation, but ILOs, masquerading as agricultural enterprises, have used the absence of laws governing agricultural pollution to avoid paying the costs of the waste generated by their operations. The reason ILOs must shift the costs of their waste to someone else is that they are faced with significant diminishing returns in their operations. This has become the central issue in the debate about the two contracts under which ILOs operate--the explicit contract that governs their relationships within the financial organization in which they exist, and the implicit contract between the ILO and the region or community in which it is located.

I. THE INDUSTRIAL ORGANIZATION AND CONTRACT ISSUES INVOLVED IN OPERATING LARGE, CORPORATE HOG FARMS AND THE IMPLICATIONS OF THESE ISSUES FOR THE COMMUNITY.

Price is the mechanism by which any market conveys the basic information about supply and demand for a good. But markets in which ILOs are employed have become very different from the old commodity-based models of agricultural production and the effects of these markets on the life and economies of local communities have changed significantly.

Initially, the issue of ILOs seems simply to be one of price and efficiency. However, to a large extent it is really an issue of information. As Jones has noted, in agriculture

[t]he critical emphasis is changing from resource allocation based on price to allocation based on strategic advantage...Until greater transparency of information in economic signals between industry levels occurs, there is a strong incentive for producers to develop formal partnerships through cooperatives, joint ventures, or vertical arrangements.⁵

These partnerships usually create two contracts of interest when a ILO enters a region such as the County of Forty Mile:

1. the contract with the ILO's organization (Taiwan Sugar Corporation--TSC) where information is equally shared and where the motives of all players are a consistent and singular search for profit, and
2. the contract between the communities in the County of Forty Mile and the ILO where asymmetrical information exists.

When a ILO enters a rural region, it strikes a bargain with the rural communities in that region. This implicit contract is usually formed around stated, but not legally enforceable, promises of jobs:

direct job estimates vary from 40 to 54 at an average wage of \$28,000 in various documents generated by the TSC⁶

and economic impact on the region:

\$25-\$27 million in economic activity will be generated annually in the area according to claims by the TSC. The company also claims that the regional multiplier for the area is 2.87. Based on this figure, the company apparently plans to spend between \$8.7 million and \$9.4 million in the local area.⁷ About \$7 million of this amount may be spent for feed in the local region.⁸ Thus, the total direct economic impact--aside from feed purchases--would only be between \$1.7 and \$2.4 million, and about \$1.5 million of this is accounted for by the direct payroll associated with 54 jobs at the hog ILO. This leaves between \$200,000 and \$900,000 for all other direct spending in the region.

The ILO promises to provide these things in return for land, water, access, power and the other factors that are required for the ILO to operate. This implicit contract also implies a certain physical relationship with the region that manifests itself in the presence (or lack) of pollution, traffic, resource consumption, etc., that arise from the operation of the ILO, and these parts of the contract are discussed in the Proposal by the TSC.

The ILO organization is typically well informed about the legal contract with its organization and the implied contract with the region because it signed the legal contract and it extended the offers on which the regional contract is based. But the citizens of the region are privy to very little information

⁵ Jones, Elund, "The Role of Information in US Grain and Oilseed Markets," *Review of Agricultural Economics*, vol. 21, no. 1, Spring/Summer, 1999, pp. 244-247.

⁶ DGH Engineering, *Development Proposal for a Farrow-To-Finish Hog Operation by Taiwan Sugar Corporation*, April, 2000, p. 56 and DGH Engineering, *What are the economic benefits to our community?*, March 6, 2000.

⁷ DGH Engineering, *Development Proposal for a Farrow-To-Finish Hog Operation by Taiwan Sugar Corporation*, April, 2000, p. 56.

⁸ Ibid.

about the ILO's explicit contract with its organization. As a result, there is an incentive on the part of the ILO to shift costs between the contracts based on each party's access to information about those costs. The party with the least information about costs is most likely to have those costs shifted in its direction.

Local, county, state, and national laws and policies on the environment and on zoning are important determinants of the location of ILO facilities.⁹ Further, these laws and policies affect the ability of ILOs to control information about their operations and they are major determinants of the role the ILO will play in the physical, social and economic environment of a region. Thus, the physical relationship between the ILO and the region is essentially predetermined by the rules and policies that are already in place in the region--and this set of rules and policies is often based on the pivotal assumptions that:

1. all agricultural operations are similar to the conventional, closed systems that previously dominated agriculture.
2. animal waste, as a natural product, while annoying, is essentially harmless, and not as toxic as human waste.
3. most animal-raising operations can be treated as if the waste that results is from ruminant animals.

For example, in a guide book for developers of ILOs, the Alberta Food Agriculture, Food and Rural Development Livestock Expansion and Development Team assures potential ILO operators that any producer using generally accepted practices [that are meant to apply to conventional agricultural operations] "would not be liable in a nuisance lawsuit; and, further could not be prevented from continuing their operation because it causes or creates a nuisance."¹⁰ As a result of these assumptions, when a ILO enters a region it encounters a set of rules that have generally been structured to control a kind of agricultural production whose inputs and waste byproducts are not representative--either in quantity or chemical composition--of the Concentrated Animal Feeding Industry.

The question here is not whether the TSC can make an implied contract with the County of Forty Mile. Instead, the issue is that in addition to this contract being physically defined around incorrect assumptions, it will also be based on asymmetrical information that heavily favors the TSC. Such a contract is likely to work in only one direction--it is likely to increase the profits of the TSC by shifting the operating costs of the ILO either to the region in which it is situated or, through some mechanism of pollution migration, to another region further removed from the ILO. The certainty of this outcome follows directly from existence of asymmetrical information about the operation of the ILO and from the motivation of the TSC.

The term asymmetrical information refers to a situation where one of two individuals in an agreement or contract possesses more information than the other individual about the nature of the bargain. If one individual possesses critical additional information about the contract, this individual can use his proprietary information to gain an advantage in the bargain. Remember that capitalism is based on the concept of full and free information about all aspects of the market--something that was easy to achieve under the traditional agricultural model where no single player was big enough to affect the market or, by implication, to operate in such a manner that it could hide information on which the market price was based and thus, shift its costs.

⁹ Hennessy, David A. and Lawrence, John D., "Contractual Relations, Control, and Quality in the Hog Sector," *Review of Agricultural Economics*, vol. 21, no. 1, Spring/Summer, 1999, p. 53.

¹⁰ *Livestock Expansion and Developer's Guide*, Alberta Agriculture, Food and Rural Development Livestock Expansion and Development Team, March, 1999, p. 1.

In theory, the permitting process used to evaluate ILO applications should insure that the citizens of a region are fully informed about all aspects of the ILO's proposed operation. If this was indeed the case, there would be no asymmetrical information. However, the nature of the permitting process-- which is usually based on incorrect assumptions that all agricultural projects are conventional in nature-- allows the ILO operator to acquire an operating permit while withholding significant amounts of information from the residents of the region. This occurs in the following ways:

1. The ILO's requirements for sterile operating facilities limit public inspection of and knowledge about the ILO and even limit the overall organizational knowledge of many ILO employees.
2. The usual position of the ILO as a contract operator for a larger, out-of-area corporate interest may limit even the ILO operator's knowledge of the source of inputs (feeds, antibiotics, etc.), the rationale behind the amounts and types of inputs selected, and the actual value of the product (the pork, chicken, etc.) to the owner.
3. Out-of-area ownership severely limits the ability of regional residents to determine the motivation, trustworthiness, and credibility of those who own and operate the ILO.
4. The short life span of ILOs (normally, eleven to twelve years due to the increasing incidence of hog disease in older facilities) and the normal practice of building ILOs as turn-key operations limits the ability of regions to establish any reliable record of ILO performance before committing to a fully-constructed operation.
5. And finally, the ILO permit approval process is often so rushed and so subject to information controlled by the ILO that residents of the region have insufficient time to learn enough about the proposal to ask intelligent questions or to do relevant research on the proposal.

A combination of these factors creates an agreement (contract) between a ILO and a region that is based on no-enforceable promises of jobs and economic development, but for which the actual information needed to validly assess the impact of the ILO on the physical, social and economic environment is withheld from the public and is available only to the owners/operators of the ILO. The result is that the county or other permitting agency has inadvertently created what economists call a moral hazard, a process that occurs when one party is better informed than the other about the characteristics of the transaction. By definition, a moral hazard leads to lower efficiency and to higher costs to the party that is least informed (in this case, a higher cost to the region that hosts the ILO.)

Having created a moral hazard, the region is now faced with a second economic condition called adverse selection. This provides an incentive for additional producers who also want to shift costs to the residents of the region to migrate to the area. Thus, additional ILOs are likely to be attracted to the region. As Milgrom and Roberts note, adverse selection is "a kind of precontractual opportunism that arises when one party to a bargain has private information about something that affects the other's net benefit from the contract and when those whose private information implies that the contract will be especially disadvantageous for the other party agree to a contract."¹¹

Casson has laid out the general outlines of the relationship that develops between the region and the ILO as a result of these factors by noting that:

the crucial question... is whether the other party to the transaction can be trusted. There are two fundamental approaches to engineering or creating trust. The one most commonly used in much of the Western world is to monitor performance through the institutional and legal system and

¹¹ Milgrom, P. and Roberts, J., Economics, Organization, and Management, Prentice Hall, Englewood Cliffs, NJ, 1992.

penalize those parties that do not fulfill their negotiated commitments. The alternative approach to engineering trust is to manipulate the incentive structure so that individuals fulfill their commitments based on rewards they receive rather than penalties they incur.¹²

For ILOs, the issue of trust is directly tied to out-of-area ownership and the asymmetrical information in the agreement between the ILO and the community. Since the motivation of an ILO such as the TSC is to create profit, not to control pollution or engage in any of the other social benefits the region may desire, the ILO can only be trusted to act in its own self interest. The interests of the region could initially be protected by disclosure of full information concerning the operations of the ILO during permitting. However, due to the factors already discussed, the ILO usually controls the information in this part of the process. The only recourse for the region is monitoring by knowledgeable regulators.

Unfortunately, monitoring measures compliance with laws that are often crippled by the same underlying assumptions about the nature of agriculture listed earlier in this section. ILOs are able to use laws based on loose, conventional agricultural standards to avoid pollution controls that would more fully assign the costs of waste to the ILOs. For example

The Taiwan Sugar Company settled on Alberta because "they felt most comfortable with the officials in government" ...government documents list Alberta's advantages for hog farmers as low grain costs, minimal taxes, abundant land and few rules. One document even promises investors that, "once established, there is no government involvement in the normal day-to-day operations of the farm," and that the province, "will remove as many regulations as possible."¹³

In addition, most of the factors that make it difficult to get information on proposed ILO operations during the permitting process also complicate attempts to monitor ILO operation. This leads to a condition called low separability. Separability is "...the feasibility to see who has done the work. With low separability, the principal [in this case, the region] will face either high control costs or intense cheating."¹⁴

So far, the history of ILO operations shows that cheating is likely. And it is made even more likely by the decision on the part of many regulating agencies to rely on citizen complaints instead of more costly professional monitoring. If monitoring fails or is not effectively implemented, the only other option for controlling the behavior of the ILO is through economic incentives. But, as previously noted, a powerful economic incentive structure is already in place and this incentive structure has been formalized in the explicit contract between the ILO, its own organization, and its investors. This contract directs the ILO to operate in such a way as to maximize profit, and if it can do this by shifting the costs of its waste to its neighbors in the region, that is how it will operate.

II. ECONOMIC EFFICIENCY AND THE NEED TO SHIFT THE COSTS OF INTENSIVE LIVESTOCK OPERATIONS TO THE LOCAL REGION

¹² Casson, M., *The Economics of Business Culture: Game theory, Transaction Costs and Economic Performance*, Clarendon Press, Oxford, England, 1991.

¹³ Nikiforuk, Andrew, "The price of bringing home the bacon", *Toronto Globe & Mail*, June 12, 2000, p. 2.

¹⁴ Sauvee, Loic, "Toward an Institutional Analysis of Vertical Coordination in Agribusiness," in *The Industrialization of Agriculture*, Jeffrey S. Royer and Richard T. Rogers, eds., Ashgate Press, Brookfield, VT, 1998, p. 55, 56.

The economic issue of efficiency in production is central to the rationale for Intensive Livestock Operations. In this argument, the economic issue usually discussed is the concept of increasing returns to scale where the efficiencies are realized when more capital is brought to a production process. The resulting capital intensive process has a much higher reliance on machines and technology and is less reliant on labor. In the ILO process, raw materials (feed, water, etc.) are submitted to hogs in confinement buildings and the output is pork.

In so far as hogs and their confinement facilities can be treated as machines, the ILO philosophy is that they can be "improved" through the addition of capital to the production process. This "improvement" comes through standardization of hog breeds and sizes, control of growth rates and animal disease, and increased specialization of workers, managers, and animal raising facilities.

If this was all there was to the ILO process, one would expect efficiency of operations to continue to increase as more capital in the form of hogs and buildings was added to the process. In other words, the maximum efficient size of hog ILOs would be extremely large. Further, this concentration would bring other benefits. For example, a former Agriculture Commissioner in Minnesota has stated that

As farms and feedlot operations get larger, there will be opportunities for important land and resource restoration to occur. Greater production of crops on fewer acres will make land available for important resource restoration activities. The prairies of the state have been mostly eliminated, and some of our most important biodiversity issues must be approached by restoring grassland habitats.... The larger farming operations will also provide greater opportunities for better management of wastes and capital intensive management methods for improved air and water quality.

The Commissioner's point is valid only if the efficiency of farm and feedlot operations continually increases as they get larger and larger. In this sense, efficiency means that average costs continue to drop. However, this is not the case. Efficiency quickly peaks as animal concentration rises because the cost of waste disposal for a ILO increases sharply after one surpasses the ability of the land to absorb the waste. The fact that ILOs try to avoid this cost by shifting the cost of their waste to the surrounding region makes no difference--the confined operation is still less efficient in an economic sense.

The Commissioner's statement also contains an unstated assumption--that the waste generated by concentrated operations stays on the site and that the land is capable of absorbing an unlimited amount of waste material. Carried to its (il)logical conclusion, the Commissioner's statement would lead one to concentrate all hogs on a single site.

There is a large body of law that already regulates problems of industrial concentration that arise from a similar condition to the one the Commissioner proposes: a point source of pollution from some concentrated industrial activity damages the health of the surrounding environment. Theoretically, a concentration of industry in various locations should, in the Commissioner's words, "[make] land available for important resource restoration activities" (because it is not covered by factories.) Instead, the waste flows from those concentrated activities ruined the surrounding environment and, in the case of acid rain, the environment thousands of miles away.

A ILO only concentrates animals in less space, it does nothing to reduce the amount of land needed to raise feed for the animals and it does nothing to reduce the amount of land that ultimately is needed to recycle the animal waste. For this reason, a switch back to conventional farming simply places the animals on the land that is also used to grow their feed and uses the animal manure responsibly to fertilize that land so that feed can continue to be grown in a more-or-less closed system. In addition, spreading the animals out in this manner reduces the need for antibiotics.

The Efficient Size of ILO Operations

Based on studies at the University of Missouri, between 1988 and 1991 only hog producers marketing less than 1,000 head annually lost market share. Between 1991 and 1994, all producers below 3,000 head marketed annually lost market share.¹⁵ And by 2000, a team of Purdue University economists found that pork industry concentration had increased to the point where the top four pork processing firms controlled 56 per cent of the business.¹⁶ However, if all the economic costs of ILO operation are considered, two economic concepts--diseconomies of scale and diminishing marginal returns--both mandate that the efficient size of most animal feeding operations should be relatively small. To understand why smaller and medium sized hog operations have lost market share to the ILO giants it is necessary to investigate how the expected effect of these two economic concepts has been altered by the actions of the ILO industry.

The first economic concept--diseconomy of scale—usually comes into play when problems associated with some element of a production process increase much faster than the size of the process itself increases. With hogs such a situation occurs with attempts to control disease and the stress factors that occur during confinement, movement and transportation. The possibility of disease among hogs is so great that a heavy use of antibiotics, limitations with respect to shed populations, the requirement to maintain a sterile site, and time limits on how long hog operations can stay in one spot all act to create diseconomies of scale. In fact, large hog ILOs are usually limited to ten to twelve years at a site before health factors become so overwhelming that they can no longer be controlled with certainty and the hog operation must abandon the site.

A second, more powerful economic concept called diminishing returns also ought to act to limit the size of efficient ILO operations. Under this concept, when units of a variable resource (such as hogs) are added to a fixed resource (such as land) one reaches a point where the marginal product (the revenue gained from the last hog added to the operation less the cost of the last hog added to the operation) of the variable resource begins to decline. Because of the costs of handling animal waste responsibly, the point at which this decline occurs is closely related to the ability of the land on which the ILO is located, and the land over which the ILO will apply its waste effluent, to absorb and recycle the manure. If diminishing returns to a ILO did not exist, all the hogs in the world could be raised on a single, small plot of land. This is clearly the philosophy of some in the hog industry who recognize no limits to hog farm growth. For example, Freese has stated that “[c]ompletely comparable costs are not publicly available to distinguish between a declining or flat average cost curve in the long run, but what is clear is that diseconomies of size are not limiting the growth of firms with 95,000 sows.”¹⁷ Such a

¹⁵ Grimes, Glen, and Plain, Ron, “The US Swine Industry - Where to from Here?,” Proceedings of Swine Strategies '95, Summer, 1995.

¹⁶ Paarlberg, Philip, “Structural Change and Market Performance in Agriculture: Critical Issues and Concerns about Concentration in the Pork Industry, Testimony before the Senate Committee on Agriculture, Nutrition, and Forestry, Washington, DC, February 1, 2000, in Anthan, George, “Hog-industry concentration assessed,” *Des Moines Register*, Washington Bureau, February 27, 2000.

¹⁷ Freese, B., “Pork Powerhouses,” *Successful Farming*, October, 1995, pp. 20-22.

statement, which completely disregards diminishing returns from hog waste and confinement, is nonsense.

To overcome these costs, ILOs have been designed to take full, economic advantage of the assumptions about agriculture listed in the previous section—assumptions that not only form the basis for ILO permitting and regulating but also establish the tax and subsidy policies that create the economic environment in which ILOs operate. These assumptions allow important costs of ILO operations to be either omitted or understated in the profit and loss calculations of the ILO. They also allow the ILO to take advantage of important tax and investment opportunities that, in effect, subsidize its operation. These factors artificially inflate the amount of profit available from ILO operations and generate short term gains for developers and investors. While this would be significant in itself, artificially inflated profits also act to draw more investment into ILO operations, contribute to the proliferation of ILOs, and provide an economic incentive for an organizational model that gives rise to the four common attributes of every ILO:

- (1) The use of capital intensive production methods. ILOs use less labor and more machinery to achieve production output.
- (2) Employment of a production methodology that maximizes tax benefits and subsidy availability to the corporation.
- (3) The use of vertically integrated operations where separate divisions of the same company produce the different stages of a product and market their output to one another.
- (4) The use of cost shifting to reduce the costs of production. Cost shifting occurs when the costs of health problems, traffic, social problems and pollution (odors, chemical and particulate air pollution; chemical, pathogen, and particulate water pollution) are transferred to the residents of a region and are neither paid by the company responsible for the costs nor included in the price of the products they market. For example, Wen-cheh Liu, the head of TSC's overseas investments, stated that

"Mounting environmental concern and criticism in recent years has made it hard to raise hogs in Taiwan. Canada is such a huge country and we can easily find a place without residents nearby."¹⁸

In other words, not paying the costs of responsibly handling its pollution in Taiwan has led to increasing criticism so TSC is moving its operations to a location where not handling its pollution responsibly will lead to less criticism. It should be noted that TSC had a clear alternative it chose not to exercise--it could have simply absorbed the costs of responsibly handling its pollution and stayed in Taiwan. The likely reason TSC chose not to take this option is that it would have reduced its profits.

In summary, arguments about the efficient size of ILO operations assume that the purpose of the organization and hence, the output of its operations, are both known and clearly specified; i.e., the purpose of a ILO may be assumed to be pork production within certain product specifications. Further, these arguments also assume that the ILO and the more conventional farming operation to which the ILO is compared both have the same fundamental production objectives. However, as the above-listed attributes demonstrate, it is not clear that pork production is the primary objective of the ILO proposed for the County of Forty Mile. Indeed, because a typical ILO is designed to

1. maximize tax benefits in both industrial and agricultural categories, and
2. maximize subsidies for both industrial and agricultural operations, and

¹⁸ "Taiwan Sugar Moves Hog Farms Offshore", [Reuters](#), January 6, 2000.

3. shift as many costs as possible to the local region while
4. producing an agricultural commodity (raising animals),

it is not clear what weight if any, one should give to efficient sizes for pork production when discussing a ILO operation. Any comparison of efficiency is further complicated by the fact that the price of ILO commodities is more likely to be set by the competitive needs of the organization as a whole (in other words, the competitive price of the final, processed products produced by the vertically integrated organization--i.e., Ramsey Pricing) than by the actual need to directly compete with other producers of pork or chicken. As a result of these factors, ILOs are also particularly ill-suited to aid in regional economic development.

III. THE ECONOMIC EFFECT OF ILO PRODUCTION ON REGIONAL ECONOMIES

The four economic characteristics of a ILO:

- (1) The use of capital intensive production methods.
- (2) Employment of a production methodology that maximizes the tax benefits.
- (3) The use of vertically integrated operations.
- (4) The use of cost shifting to reduce the costs of production.

are fundamentally incompatible with regional economic development. Regional economic development proceeds on the premise that the wages paid and purchases made by a company are transferred to other individuals or companies in the region. The multiplier effect of these payments further assumes that they are again spent within the confines of the region and that they do not “leak” into other areas of the state or nation. However ILOs are structured so that they cannot aid regional economic development for the following reasons:

(1) Constraints on Regional Economic Development Due To Employment

As a capital intensive company, a ILO is designed to minimize the number of workers and hence, minimize the economic impact on the region. A 1998 Colorado State University study found that only 3-4 direct jobs (jobs with the hog producer) are created for every 1000 sows in a ILO sow farrowing operation.¹⁹ This estimate is in line with the TSC's claim that it will hire 40 people in its farrow-to-finish operation.

Ikerd calculated that large farrow-to-finish contract hog operations employ about 4.25 people to generate over \$1.3 million in revenue. His figures show that an independently operated hog farm would employ about 12.6 people to generate the same amount of hog sales.²⁰ Based on this estimate, if the same increase in hog production levels proposed by the TSC were achieved simply by expanding the herd size on existing conventional hog farms, three times as much employment--or 120 jobs--would be created in the region.

Depending on the region, the employment multiplier for agriculture varies from 1.8 to 2.2 for every direct employee (thus, indirect and induced impacts on related economic sectors of the economy would create 1.8 to 2.2 total jobs for each person employed in hog production.) However, if one treats ILOs as industrial operations, the multiplier is much lower--about 1.35.²¹

It is likely that even this figure overstates the economic impact on a rural county such as Forty Mile. For the employment multiplier to operate at the levels specified in the TSC Proposal, all employees must both live and work in the county. Given the ability to commute, it is likely that many workers will live well outside the region and that the actual employment multiplier will be further depressed.

The size of the employment multiplier further depends on amount of purchases a ILO makes in the region. However, large scale animal production facilities are more likely to purchase their inputs

¹⁹ Park, Dooho, Lee, Kyu-Hee, and Seidl, Andrew, “Rural Communities and Animal Feeding Operations,” Department of Agricultural and Resource Economics, Colorado State University, Ft. Collins, CO, 1988.

²⁰ Ikerd, John E., “Sustainable Agriculture: An Alternative Model for Future Pork Producers,” in The Industrialization of Agriculture, Jeffrey S. Royer and Richard T. Rogers, eds., Ashgate Press, Brookfield, VT, 1998, pp. 281-283.

²¹ RIMS II, Department of Commerce, Bureau of Economic Analysis, Washington, DC, October, 1997.

from a great distance away, bypassing local providers in the process.²² A 1994 study by the University of Minnesota Extension Service found that the percentage of local farm expenditures made by livestock farms fell sharply as size increased. Farms with a gross income of \$100,000 made nearly 95% of their expenditures locally while farms with gross incomes in excess of \$900,000 spent less than 20% locally.²³

Confined animal production can occasionally benefit local grain sellers, but only when it consumes all the grain produced in the county. If the county has to export even one bushel of grain, all the grain in the county will have to be priced at a lower level that will enable the grain to compete in the export market.²⁴ When grain is priced at the export level the only beneficiary of purchasing locally is the hog ILO which saves on transportation costs.

(2) Constraints on Regional Economic Development Due To Taxes

National, state and local taxes are levied on taxable amounts calculated on national returns. The numerous tax write-offs that are possible because ILOs are sometimes treated as industries and, at other times, treated as farms, significantly decrease the amounts of taxes paid locally. At the same time the operations of the ILO create social, health and traffic costs that the local government must finance. The local government, in turn, must rely on increased taxes to pay these ILO-induced costs--and this can decrease other economic activity in the region.

For example, additional costs associated with hosting a ILO include increased health costs, traffic, accidents, and repairs. One Iowa community estimated that its gravel costs alone increased by about 40% (about \$20,000 per year) due to truck traffic to hog ILOs with 45,000 finishing hogs. Annual estimated costs of a 20,000 head feedlot on local roadways were \$6447 per mile due to truck traffic.²⁵ Colorado counties that have experienced increases in livestock operations have also reported increases in the costs of roads, but specific dollar values are not available.²⁶ In addition, an Iowa study found that while some agricultural land values increased due to an increased demand for "spreadable acreage," total assessed property value, including residential, fell in proximity to hog operations.²⁷

(3) Constraints on Regional Economic Development Due To Vertical Integration

Vertical integration requires purchases from and sales to other members of the vertically integrated company, not from local producers and suppliers. Thus, vertically integrated companies stimulate regional economies only to the extent that all elements of the company are located in the region. Historically, this factor has severely limited the economic impact of ILOs on the regions in which they are situated. For example, Lawrence found that in Iowa smaller hog operations (less than 700 head annually) purchased 69 percent of their feed within 10 miles of the operation. Large hog operations (2000 or more hogs per year) that are more likely to be vertically integrated only purchased 42 percent of their feed within 10 miles of the operation.²⁸

²²Lawrence, John D., et al., "A Profile of the Iowa Pork Industry, Its Producers, and Implications for the Future," Staff Paper No. 253, Department Of Economics, Iowa State University, 1994.

²³ Chism, John, and Levins, Richard, "Farm Spending and Local Selling: How Do They Match Up?," Minnesota Agricultural Economist, no. 676, University of Minnesota Extension Service, Spring, 1994.

²⁴ Hayes, Dermot, Iowa's Pork Industry--Dollars and Scents, Iowa State University, January, 1998.

²⁵ Duncan, M.R., Taylor, R.D., Saxowsky, D.M., and Koo, W.W., "Economic Feasibility of the Cattle Feeding Industry in the Northern Plains and Western Lakes States," Agricultural Economic Report No. 370, Department of Agricultural Economics, North Dakota State University, 1997.

²⁶ Park et al., op. cit.

²⁷ Ibid.

²⁸ Lawrence et al., op. cit.

(4) Constraints on Regional Economic Development Due To Cost Shifting

The previous three sections have described the reasons inherent in the structure of ILOs that most of the money from a ILO will either be directly spent outside the region or it will quickly migrate there. However, through cost shifting the ILO will leave the costs of its odor, health risks, surface water pollution, ground water pollution and in the long run, its abandoned lagoons and facilities for the region to deal with. This directly effects both long and short run economic development.

Put bluntly, every company has many choices of location and active recruitment is practiced by most regions. Quality of life is a major factor in decisions to locate in a region, and most companies would never consider locating in an area where an ILO is operating. In addition, large hog farms adversely impact the value of neighboring property in the region.

Palmquist et al., in a 1995 study in North Carolina, found that neighboring property values were affected by large hog operations based on two factors: the existing hog density in the area and the distance from the facility. The maximum predicted decrease in real estate value of 7.1 percent occurred for houses within one-half mile of a new facility in a low hog farm density area. A 1997 update of this study found that home values decreased by \$.43 for every additional hog in a five mile radius of the house. For example, there was a decrease of 4.75% (about \$3000) of the value of residential property within 1/2 mile of a 2,400 head finishing operation where the mean housing price was \$60,800.²⁹ A 1996 study by Padgett and Johnson found much larger decreases in home value than those forecast by Palmquist. In Iowa, hog ILOs decreased the value of homes in a half-mile radius by 40%, within 1 mile by 30%, 1.5 miles by 20% and 2 miles by 10%.³⁰

IV. FACTORS INHERENT IN LARGE ILO PRODUCTION THAT WILL RESULT IN SUBSTANTIAL DIMINISHING RETURNS TO THE PROPOSED TSC ILO OPERATION

Based solely on the law of diminishing returns, one would expect that as larger amounts of animal waste are handled and as more animals are crowded into confined spaces in close proximity to one another, the potential for disease and the costs of waste handling both mandate that the maximum efficient size of a ILO is relatively small. Thus, for a large ILO to compete with other agricultural producers, these costs must be offset by benefits from other phases of the operation such as:

- (1) using animal waste for methane generation (a technique TSC used in Taiwan) or fertilizer application or
- (2) offsetting the problems of proximity and the cost of antibiotics this requires through efficiencies that come from reduced labor requirements and/or standardization.

If these benefits cannot compensate for the increased costs of ILO operation, the additional costs arising from diminishing returns must either be shifted away from the large ILO producer so they are not reflected in the accounting cost of production or it is likely that the large ILO producer will not be able to compete. And based on the newspaper accounts of TSC's decision to leave Taiwan, this is apparently the exact situation they encountered.

Whether or not the costs of preventing disease through crowding are recouped through efficiencies that arise from reduced labor and standardization is irrelevant to this discussion because these costs and benefits are completely overwhelmed by the costs of handling the animal waste. As a

²⁹ Palmquist, R. B. et al., "The Effects of Environmental Impacts from Swine Operations on Surrounding Residential Property Values," Department of Economics, North Carolina State University, Raleigh, North Carolina, 1995.

³⁰ Park et al., op. cit.

result, the economic viability of a ILO can be evaluated solely by comparing the costs and benefits of handling animal waste. For example, take the case of swine production in a typical ILO where:

- (1) each hog produces 1.9 tons of waste annually.
- (2) each hog generates .064 pounds of nitrogen per day or 23 pounds per year.
- (3) each hog generates .0213 pounds of phosphorus per day or 7.8 pounds per year.³¹

Responsibly Handling ILO Waste

The primary goal of all waste treatment is to eliminate pathogens. A secondary goal is to reduce the biochemical oxygen demand (BOD--the carbon and nutrient substrate for microbial decomposition) so that the waters that receive waste runoff do not become anaerobic. Finally, some heavy metals must be removed before the waste is discharged. In a sewage treatment plant for human waste, aerobic decomposition kills human pathogens and reduces the BOD while the settling process removes heavy metals to sludge (which then must be safely disposed of).

Table 1
Pollution Strength of Livestock and Municipal Waste

Type of Waste	BOD5 mg/l	Ammonia, NH ₄ N mg/l
Undiluted Livestock Waste	40,000	10,000
Manure Lagoon Effluent	14,400	-
Runoff From a Concrete Lot	1,000	-
Runoff From a Dirt Lot	500	-
Raw Municipal Sewage	250	50
Treated Municipal Sewage	30	1.5

Source: Understanding the Pollution Potential of Livestock Waste, Illinois Environmental Protection Agency, 1991.

One reason the concept of diminishing returns should be a powerful deterrent to large ILOs is that the cost of responsibly handling and treating animal waste is so high. Anaerobic decomposition in animal waste lagoons does not eliminate human pathogens and BOD, and it leaves heavy metals in the lagoon. As opposed to assumptions about its “natural and thus, harmless, nature,” livestock manure creates pollution with a strength that far exceeds raw municipal sewage. As Table 1 shows, the BOD concentration in undiluted livestock waste is 160 times more powerful than raw municipal sewage and ammonia is 200 times more concentrated. Even after it has been flushed to lagoons, manure effluent is still 57 times more powerful than raw sewage.

Exposure of land-applied wastes to sunlight and microbial activity in the soil will generally finish the job of pathogen control, and the nutrients that affect BOD may be used by crop plants. In effect, application to farm land is a final step in the “treatment” of animal waste if the amount of land to which it is applied is sufficient to perform this function.³² For this reason, the TSC's proposal to inject hog waste directly into the ground to suppress odors is troubling. Injection nullifies efforts to expose hog waste to the air and to sunlight to destroy human pathogens, and the injected waste is likely to carry those pathogens into the soil and then into water that may be consumed by humans.

³¹ “Hog Waste,” Get the Facts: Fact Sheets, Environmental Defense Fund, 1999.

³² Lasley et.al., Op. Cit., pp. 14-15.

Whatever method is chosen for land application, construction of lagoons to hold the effluent until it can be applied to the land is also required. This implies that the ILO has enough land for responsible nutrient application, and it further implies that the number of animals at the ILO has been determined based on the amount of spreadable acreage available--and not vice-versa. It also implies sufficient, leak-free lagoon capacity to see the ILO through the months in which the waste is not applied. In sum, the requirement to spread the waste to kill pathogens creates a significant transition point in the ability of the ILO to responsibly handle waste. Appendices 1 and 2 show that for hogs this point is relatively easy to calculate:

At a rate of 25 pounds of Nitrogen/acre:

The proposed operation needs about 50,000 acres annually for continuous cropping (the assumption used in the TSC calculations--Proposal, p. 33). The operation would require 100,000 acres if the land was allowed to go fallow every other year--a very common practice in the County of Forty Mile.

At a rate of 50 pounds of Nitrogen./acre:

The proposed operation would need about 25,000 acres for continuous cropping and 50,000 acres if the land is allowed to fallow every other year.

None of these figures is close to the 14,000 acre requirement given in the TSC Proposal.

At a rate of 10 pounds of P₂O₅/acre:

The proposed operation needs about 100,000 acres annually for continuous cropping (the assumption used in the TSC calculations--Proposal, p. 33). The operation would require 200,000 acres if the land is allowed to go fallow every other year--a very common practice in the County of Forty Mile.

At a rate of 25 lb./acre:

The proposed operation would need about 40,000 acres for continuous cropping and 80,000 acres if the land is allowed to fallow every other year.

None of these figures is close to the 17,000 acre requirement given in the thirty-year plan in the TSC proposal. 34,000 acres are cited by TSC as the long-term requirement to avoid phosphorus buildup in the soil. This number appears to have been calculated based on an annual application rate of 30 pounds per acre--a rate of application that would assure phosphorus buildup in the soil. It is not surprising that TSC's own consultant on phosphorus use cautions that "Annual testing of surface (0 to 15-cm) and sub-surface soils will be required to monitor available P concentrations and ensure that critical levels of soil test P are not exceeded."³³

Thus, even at the highest nutrient application rates, the proposed operation would need about 50,000 spreadable acres for the nitrogen generated by the operation and about 80,000 acres for the phosphorus if the land is allowed to go fallow every other year. Securing this required spreadable acreage will be a daunting task. At the present time, TSC has not secured sufficient acreage to spread manure even with the promise that the manure will be free for the next ten years.

When an ILO is located in areas where the climate is unfavorable for spreading for major parts of the year or where the soil is so poor that few crops are grown and little spreading can occur, spreading the waste on the land often turns out to be impractical. Many ILOs have realized this and their response has been to simply hold the waste in large lagoons until it evaporates. This creates three major problems: First, lagoons leak. Second, lagoon storage does nothing to destroy the pathogens in the waste. And third, the materials in the waste--nitrogen, phosphorus, heavy metals, and salts--are now

³³ DGH Engineering, Development Proposal for a Farrow-To-Finish Hog Operation by Taiwan Sugar Corporation, April, 2000, Appendix H, p. 3.

concentrated in pits for which there are usually no remediation plans even though they would qualify as hazardous waste dumps based on the chemical makeup of the materials they contain.

Water Use At TSC's Proposed Operation

The sections in the TSC Proposal devoted to discussions of water use are somewhat opaque. These sections claim to show total annual water consumption but they appear to be based solely on drinking water consumption by the hogs in the sheds--the water usage shown is far too low for a flush system even if the various assumptions and promises made by TSC in their proposal are taken into account.

Appendix 3 shows the expected water use for a flush operation with the number of hogs proposed by TSC. The likely total water use by TSC's proposed operation would range from about 420 million imperial gallons per year to about 375 million imperial gallons per year instead of the 45.4 million imperial gallons claimed in the TSC Proposal, and these figures do not account for the on-site mill and truck wash.

The County of Forty Mile is relatively arid and its residents are very mindful of the need to conserve water. The usage rates calculated in appendix 3 would have a definite impact on water availability in the county. It is worth noting that Appendix G of the Proposal investigates areas of groundwater availability in a 4400 square kilometer region around the town of Bow Island. This would appear to be an extremely large area to draw water from if the usage at the proposed sites is really as small (160-170 acre feet) as TSC says it is.

Appendix 1

Calculations Of Spreadable Acreage Requirements Based on Nitrogen

Total excreted N/head/day³⁴:

Gestating Sow: .0421 lb./head/day (169 days) (2 cycles) (7200 sows)
=102,454 lb./year.

Farrow Sow w/litter: .1318 lb./head/day(14 days)(2 cycles)(7200 sows)
= 26,571 lb./year.

Nursery Pig: .0162 lb./head/day (42 days)(2 cycles) (10) (7200 sows)
= 97,977 lb./ year.

Finish Pig: .0588 lb./head/day (120 days) (2 cycles) (10) (7200 sows)
= 1,016,064 lb./ year.

Total = 1,243,066pounds of nitrogen per year.

Assume an average application rate of 25-50 lb./acre for typical crops in the County of Forty Mile.

Then at a rate of 25 lb./acre:

The proposed operation needs about 50,000 acres annually for continuous cropping (the assumption used in the TSC calculations--Proposal, p. 33). The operation would require 100,000 acres if the land was allowed to go fallow every other year.

At a rate of 50 lb./acre:

The proposed operation would need about 25,000 acres for continuous cropping and 50,000 acres if the land is allowed to fallow every other year.

³⁴ Source for nitrogen excreted per head: Nitrogen Estimate, Agri-Waste Technology, for Midwest Farms, LLC, Disk MWF 3, May 1, 1997.

Appendix 2

Calculations Of Spreadable Acreage Requirements Based on Phosphorus

Hog waste, especially sludge from the bottom of pits and lagoons, is typically phosphorus enriched relative to crop needs. The ratio of available nitrogen to phosphorus from hog manure can be up to 1.5:1, whereas corresponding requirements for corn grain is about 6:1.³⁵ Similar studies in Colorado yielded a nitrogen/phosphorus ratio of 5:1 for corn in Yuma County, Colorado.³⁶ Further, "... Ohio has recently changed its recommendations, so that wastes are spread according to the phosphorus, rather than the nitrogen needs of the crop. Thus, more crop land is needed for disposal."³⁷

Given that ratios that can be up to 1.5 to 1, nitrogen to phosphorus, assume a more conservative ratio of 2 to 1.

Total P/head/day--normal operations:

Gestating Sow: .0211 lb./head/day (169 days) (2 cycles) (7200 sows)
=51,349 lb./ year.

Farrow Sow w/litter: .0659 lb./head/day(14 days)(2 cycles)(7200 sows)
= 13,285 lb./year.

Nursery Pig: .0081 lb./head/day (42 days)(2 cycles) (10) (7200 sows)
= 48,988 lb./year.

Finish Pig: .0294 lb./head/day (120 days) (2 cycles) (10) (7200 sows)
= 508,032 lb./year.

Total = 622,654 pounds of phosphorus per year.

TSC claims it will use the enzyme phytase in its feed rations and that this will decrease the amount of excreted phosphorus by roughly 30 %. Thus, with phytase added the amount of phosphorus excreted can be expected to be 435,000 pounds (or about 1 million pounds of P₂O₅)--figures that are almost identical to the ones calculated by TSC.

Assume an average application rate of 10-25 lb./acre for P₂O₅ for typical crops in the County of Forty Mile.

Then at a rate of 10 pounds per acre:

The proposed operation needs about 100,000 acres annually for continuous cropping (the assumption used in the TSC calculations--Proposal, p. 33). The operation would require 200,000 acres if the land is allowed to go fallow every other year.

At a rate of 25 lb./acre:

The proposed operation would need about 40,000 acres for continuous cropping and 80,000 acres if the land is allowed to fallow every other year.

³⁵ Pennsylvania State University, The Agronomy Guide 1995-1996, College of Agricultural Sciences, The Pennsylvania State University, University Park, PA, 1994.

³⁶ Al-Kaisi, Mahdi, and Waskom, Reagan, Summary Report: Swine Effluent Study 1995-1997, Department of Soil and Crop Sciences, Colorado State University, 1998, p.5.

³⁷ Understanding the Impacts of Large-Scale Swine Production, Proceedings from an Interdisciplinary Scientific Workshop, Des Moines, IA, June 29-30, 1995, p. 30.

Appendix 3

The Use of Water In Large ILO Hog Operations

Normal water use in a hog confinement system is related to the actual water consumption of the hogs, plus the amount of fresh water used to clean the facility and flush the gutters, plus any fresh water used to help refill the lagoons after occasional sludge removal. Finishing hogs drink three to four gallons per day. Facilities that use fresh water to flush the gutters in hog facilities may use an additional 15 gallons per finishing hog or 35 gallons per sow and litter per day.³⁸

Normal Drinking Water Use:

Total drinking water consumption/head/year:(Source of figures:³⁹)

Gestating Sows: 5 gallons/head/day (169 days) (2 cycles) (7200 sows)
= 12,168,000 US Gals/ year or 10,342,800 imp. Gals/year.

Farrow Sow w/litter: 7 gallons/head/day(14 days)(2 cycles)(7200 sows)
= 1,411,200 US Gals/year or 1,213,632 imp. Gals/year.

Nursery Pig: 3 gallons/head/day (42 days)(2 cycles) (10) (7200 sows)
= 18,144,000 US Gals/year or 15,422,400 imp. Gals/year.

Finish Pig: 4 gallons/head/day (120 days) (2 cycles) (10) (7200)
= 69,120,000 US Gals /year or 58,752,000 imp. Gals/year.

Total = 85,730,832 imperial gallons of drinking water per year or
234,879 imperial gallons of drinking water per day.

In one of its "Project News Letters, TSC makes the claim (not repeated in its other publications) that "new and improved pig feeding and drinking devices cut water use by up to 50% by preventing spillage and waste."⁴⁰ While statistics that use the words "up to" allow for any usage decrease from zero to 49% and hence, are essentially meaningless, assume that a 50% reduction was achieved. This equates to a usage rate of about 117,000 imperial gallons per day--or exactly the rate stated by TSC.⁴¹ [Note: in the Proposal, this figure is given as 124,400 imp. Gals/day (p. 9)] Thus, TSC's figure is the most optimistic estimate of the lowest possible drinking water use. This optimistic figure does not include any flushing water--and flushing is the major use of water in a confined hog operation.

Normal Flushing Water Use:

Total waste flushing water /head/year:(Source of flushing water figures:⁴²)

Gestating Sow: 15 gallons/head/day (169 days) (2 cycles) (7200 sows)
= 36,504,000 US Gals/ year or 31,028,400 imp. Gals/year.

Farrow Sow w/litter: 35 gallons/head/day(14 days)(2 cycles)(7200 sows)
= 7,056,000 US Gals/ year or 5,292,000 imp. Gals/year.

Nursery Pig: 15 gallons/head/day (42 days)(2 cycles) (10) (7200 sows)
= 90,720,000 US Gals/ year or 77,112,000 imp. Gals/year.

Finish Pig: 15 gallons/head/day (120 days) (2 cycles) (10) (7200 sows)
= 259,200,000 US Gals/year or 220,320,000 imp Gals/year.

³⁸ Structures and Environment Handbook, 11th Edition, 2nd Revision, Midwest Plan Service, Iowa University, Ames, Iowa, 1987 in Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

³⁹ Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

⁴⁰ Taiwan Sugar Corporation, Project News, April, 2000, p. 3.

⁴¹ DGH Engineering, How much water will the proposed operation require?, March 6, 2000.

⁴² Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

Total = 333,752,000 imp. gallons of flushing water per year or
914,389 imperial gallons of flushing water per day.

TSC states that "The manure in the barns is frequently flushed to the covered storages, therefore, there is no habitat for flies to breed."⁴³ This matches standard practice in the flush systems just described and would require the amounts of water just calculated. However, in only one of its other documents, TSC claims that "Barn washing accounts for just 10% of total water use..."⁴⁴ Since no figures for flushing water use are provided in either case, and since the 10% of total water consumption figure matches neither TSC's own statements of frequent flushing nor any of the figures provided by TSC, it is assumed that the figures calculated in this section are the best estimate of flushing water use.

Thus, likely total water use by TSC's proposed operation would range from about 420 million imperial gallons per year to about 375 million imperial gallons per year--amounts that vastly exceed the 45 million imperial gallons claimed in the TSC Proposal. These figures do not account for the on-site mill and truck wash.

⁴³ DGH Engineering, Development Proposal for a Farrow-To-Finish Hog Operation by Taiwan Sugar Corporation, April, 2000, p. 53.

⁴⁴ Taiwan Sugar Corporation, Project News, April, 2000, p. 3.