STELCO'S LAKE ERIE WORKS

By

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Abstract

The major emphasis of this paper concerns the location of Stelco's Lake Erie Works at Nanticoke. The paper puts into perspective Stelco's decision to build a new integrated steel works. Stelco had to increase its capacity by an estimated six-million tons to ensure its competitiveness up to the year 2000. Hilton Works could at best only produce a five and a half to six million ton annual capacity and had no room available to expand its operation.

Stelco therefore set out on an intense search to find a suitable location to develop a new integrated steel plant. Nanticoke Ontario, on the north shore of Lake Erie, was finally chosen as the site. Overall, the differences between Hamilton and Nanticoke are small and it was chiefly the space available and better labour relations at Nanticoke that influenced Stelco's choice of location. Construction of Lake Erie Works began in 1974 and the first phase was completed in 1980.

Acknowledgements

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M.A.L.

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Introduction

Economic geography represents a merging of the economists concerns about scarcity and the geographers interest in spatial patterns and processes. That is, economic geography deals with the spatial aspects of economic systems. One important body of theory in economic geography focuses on the location of industrial activities. This theory attempts to explain spatial distributions of various kinds of manufacturing activities.

The purpose of this paper is to examine the theory of industrial location and its relevance to the location of the iron and steel industry in Southern Ontario. The research described in this paper will focus on Hamilton and Nanticoke as industrial sites. The location factors of land, labour, transportation and markets will be used as the independent variables to assess the advantages and disadvantages of each location. The study will attempt to demonstrate that the differences between Hamilton and Nanticoke are small, except for the space available. Therefore, the investigation will point out that it was the lack of necessary expansion space in Hamilton along with the issue of labour relations that influenced Stelco to choose Nanticoke as the location to build its new integrated steel plant.

The paper is structured as follows. First a history of the steel industry in Hamilton is presented. Included in this history is an examination of the reasons for the industry's presence in Hamilton. Second, important concepts from industrial location theory in the tradition of Alfred Weber will be discussed. In addition studies pertaining to steel plant location in North America will be reviewed. Third, reasons for Stelco's initial choice to expand, the sites considered, and why Nanticoke was selected as the location for Stelco's new steel plant will be examined. Finally, site and situational characteristics such as transportation, labour and land will be used to assess the advantages and disadvantages of the Hamilton and Nanticoke installations.

The Steel Industry in Hamilton

The purpose of this section is to provide a brief description of the early beginnings of the steel industry in Hamilton. Specifically this section will deal with those aspects of land, labour, and transportation which promoted the growth of the industry.

Hamilton is by far the most important steel producing centre in Canada, with Stelco and Dofasco accounting for almost 60 percent of Canada's domestic steel output today (Norcliffe, 1983, p.4). Stelco, in its peak year of 1980, produced 6.28 million tons of steel, making sales of $2228 million with a workforce of 25,094 people (Stelco, Annual Report, 1982, p.27). Even though the recent recession has had a detrimental effect on steel sales, Stelco produced roughly 4.6 million tons of steel in 1982 with sales of $2,020 million (Stelco, Annual Report, 1982, p.27). Despite this downturn in business, Stelco still remains the leading steel maker in Canada. The following examination of the history of steel production in Hamilton will provide an explanation for the city's dominance.

The development of the modern iron and steel industry in Hamilton began in 1895 with the building of the first blast furnace, followed two years later by a steel mill. The City Council of Hamilton played a key initiating role by providing a free site for the plant, a long term exemption from local taxes and a cash payment if expansion proceeded at a determined rate (Kerr, 1967, p.142). By 1897 Hamilton's steel industry continued to expand largely because of the use of high quality hematite ore from Minnesota. Low grade Ontario ore created too many difficulties in the smelting process.

In 1910, the Hamilton Steel Company, which had become Canadian owned, merged with Montreal Rolling Mills, Dominion Wire of Lachine Quebec, Canadian Bolt of Toronto, Gananque, Belleville, and Brantford and Canadian Screw of Hamilton to form the Steel Company of Canada (STELCO) (Kerr, 1967, p.142).

The merger was largely the work of a financier, Max Aitken, who later became Lord Beaverbrook. The Steel Company of Canada was initially capitalized at $25 million and faced its first obstacle to growth - cheap American steel (Spectator, Sept 16, 1980, p.5b).

Stelco, Under its first president, Charles Wilcox, decided to meet this competition by increasing its open-hearth furnace capacity from 80,000 to 200,000 tons (Spectator, Sept 16, 1980, p.5b). In addition, a finishing mill was constructed. Stelco assumed its most important trademark at this point, constant innovation. The best available technology was sought and incorporated into their steel mill. By 1913 when expansion was completed, Stelco had the worlds second electrically powered bloom mill (a bar of steel rolled from an ingot) and an electrical powered rod and bar mill (Spectator, Sept 16, 1980, p.5b).

Just as the new equipment was installed, a mild recession occurred and business fell drastically. By the outbreak of the First World War, Stelco was close to bankruptcy. Stelco, however, fought back. It encouraged Great Britain to purchase Canadian made shells as opposed to American, even though the Americans had the necessary experience and equipment to produce artillery shells. Canadian shells were produced for the British Army by Stelco and were second to none in quality. It was the need for shells and other war supplies that financially put the company back on its feet. It was also during the First World War that Stelco acquired coalfields in Pennsylvania and iron ore mines in Minnesota.

Business boomed after the war due to returning veterans becoming consumers of new durable goods. These sales helped to strengthen Stelco's financial base for the problems of the 1930's. Despite the start of the Depression in 1929, Stelco was financially strong enough to weather the lean years, although at one point it was forced to sell its coke as home heating fuel to acquire capital (Spectator, Sept 16, 1980, p.5b).

With the outbreak of the Second World War in 1939, defense spending put life back into Stelco. Stelco produced many war supplies, particularly shells, armour plate, and steel plate for Canada's Corvette Navy. After the war business did not decline, rather production grew at a rate unprecedented in the company's history. Stelco, as a supplier for pipeline projects in the West underwent a series of expansions. (See figure 1.)

Figure 1

		Total
Stelco Hamilton	1957	2.15
	1966	3.95
	1975	5.396
	1982	4.592

Raw Steel Production in Millions of tons

Source: Stelco - Public Affairs Department

Stelco, however in 1970, moved its head office from Hamilton to Toronto to take advantage of the business climate within that city.

Dofasco, Canada's second largest steel company was founded in 1912 by Clifton W. Sherman. The young company which had an 80-ton daily capacity employed about 150 people, supplied steel castings to the locomotive and freight car builders (Dofasco, 1982, p.1).

Dofasco's early years were marked with lean and discouraging periods. Even then, however, Dofasco began to gain a reputation for innovation in both production techniques and employee relations. Most significant of the employee relations was the institution in 1938 of the Dofasco Profit

Sharing Plan which allowed employees to share in the profits they helped to create. Partly because of the Profit Sharing Plan, Dofasco remains the largest non-unionized steel company in the world today.

Dofasco became a fully integrated steel mill in 1951 when its first blast furnace and coke oven battery were completed. Dofasco has grown remarkably since then and has continued its role as a technical leader in steel production. One example of its technological innovations occurred in 1957 when it was the first steel producer in North America to replace the open hearth method with the basic oxygen furnace (Norcliffe, 1983, p.4).

Dofasco, like Stelco, also acquired iron ore and limestone supplies. Dofasco participates in mining developments in both Temagami and Kirkland Lake, Ontario and Wabush Lake in Labrador. In addition, Dofasco has recently acquired Beachvelime and DoLime, lime and limestone product producers located near St. Thomas and Guelph, Ontario respectively. Dofasco subsidiaries include National Steel Car of Hamilton and Prudential Steel Limited of Calgary, a leading producer of pipe for the oil and gas industry in Western Canada. (See figure 2.)

Figure 2

		Total
Dofasco Hamilton	1957	.936
	1966	2.15
	1977	3.333
	1982	3.636

Raw Steel Produced in Millions of tons

Source: Dofasco - Public Affairs Department

Concerning the physical site characteristics, Hamilton's harbour is the best sheltered natural harbour on the Canadian side of the Great Lakes. Today, Stelco and Dofasco dominate the Bayfront area of Hamilton as the two steel firms own 1,700 acres (70 percent of the industrially zoned land), and have over 13 million square feet of industrial floorspace (Norcliffe, 1983, p.4). (See figure 3.) Hamilton is the only major port city in Canada in which large scale industry still dominates the central waterfront (Norcliffe, 1983, p.2).

The production of steel requires large quantities of raw materials. Foremost among these is coal, which is converted into coke for use in the blast furnace as a source of fuel. Coke is a perfectly gross material meaning that of the entire weight of that input none of it enters into the output or product. Other materials are iron ore, water for cooling, scrap steel and limestone is needed as a form of flux (promotes the formation of slag). Overall, 0.6 net

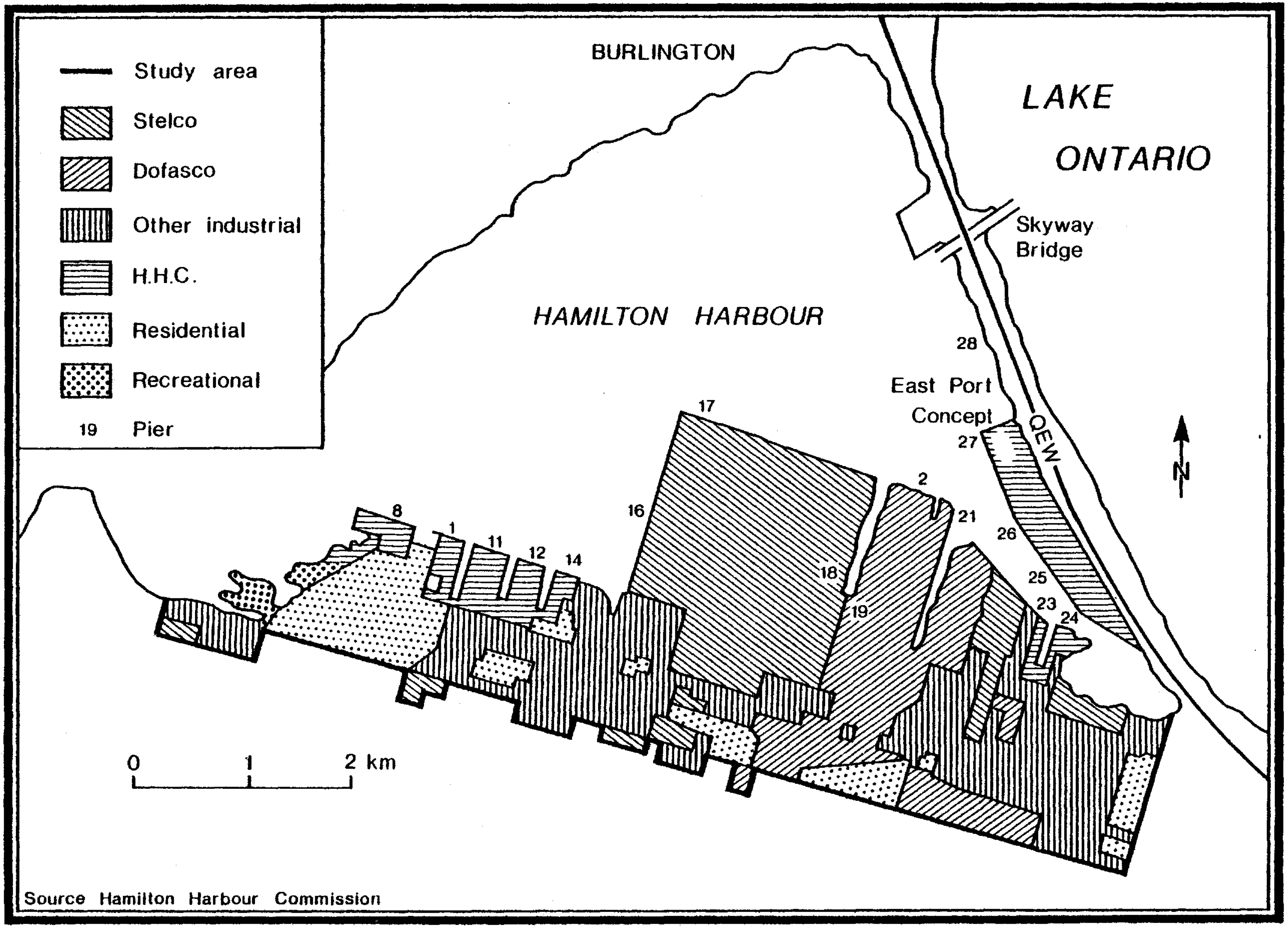

Study area
Stelco
Dofasco
Other industrial
H.H.C.
Residential
Recreational
19 Pier
BURLINGTON
LAKE
ONTARIO
Skyway
Bridge
HAMILTON HARBOUR
28
East Port
Concept
17
27
QEW
N
2
8
1
11
12
14
16
21
26
18
25
19
23
24
0 1 2 km
Source Hamilton Harbour Commission

FIGURE 3

tons of coal, 0.985 tons of ore, 0.5 net tons of scrap, and 0.1525 net tons of fluxes are needed to produce each net ton of steel (Stelco, December 2, 1983, p.1). (See figure 4.)

Figure 4

	Iron Ore+	Coal	Total Steel Produced
1983	4.517	2.551	4.778
1982	2.989	2.2931	4.592
1981	4.753	2.336	4.454
1980	5.897	3.2183	6.278
1979	5.199	3.4697	5.862
1978	5.548	3.151,7	5.533
1977	4.601	3.089,3	5.64
1976	5.11	3.260,3	5.724
1975	4.409	4.021,6	5.396
1974	4.893	2.600,98	5.542
1973	5.151	3.014,9	5.723

1973 - 1983 Statistical Summary of iron ore and coal received and Raw Steel produced (Millions of tons) for Stelco
+ Blast furnace feed - including sinter (Gross tons)

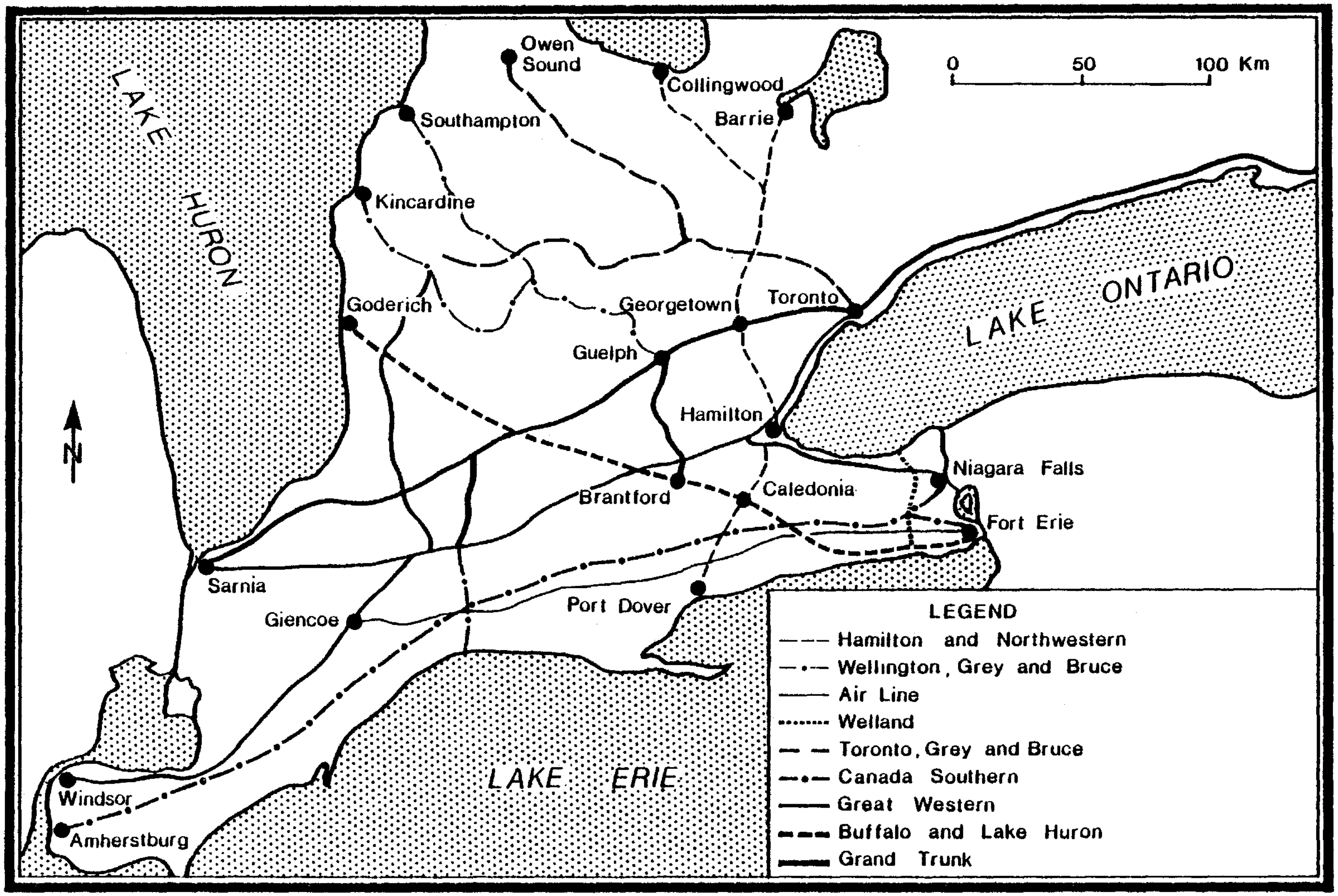
Source: Stelco Public Affairs Department, 1984

Hamilton is located halfway between coal sources from the United States and iron ore sources from Quebec and Labrador. Limestone is mined locally and scrap is available in large quantities in Southern Ontario. High grade coking coal for Stelco comes from the Chisholm mine in Phelps, Kentucky along with Stelco's Madison Mine in Ashford, West Virginia. The two mines supply two million tons of coal each year which represents 40 percent of Stelco's annual needs and is worth about $70 million U.S. (Spectator, January 9, 1982, p.65). Stelco's principal iron ore mines are located at Red Lake, in northern Ontario (Griffith Mine), Minnesota and the Wabush Mines located in Labrador. All iron ore is pelletized or concentrated into pellet form at the mine. Ore from the Wabush mines travels to Sept Iles Quebec where it is loaded on bulk carriers and transported to Stelco's Hamilton works. No Wabush ore travels to Nanticoke. The Griffith Mine is 100 percent owned by Stelco, while the company owns 25.6 percent of the Wabush mine operation (Stelco Annual Report, 1982, p.29). Although Hilton Works produces much inplant scrap, during times of peak business conditions, Stelco will purchase scrap from local suppliers, i.e., Waxman, to further increase its scrap supply. Limestone, because of the small quantities used, exerts no locational influence on steel plant location. Limestone is trucked from Stelco's facility in Beachville Ontario, and water is also easily drawn from Hamilton Bay.

In dealing with water transportation, the construction of the Welland Canal in 1829 (completed) gave an enormous boost to Hamilton's expanding steel industry. With the subsequent deepening of the canal in 1887, Hamilton had an accessible route to low-priced, high-quality coking coal from the U.S. This coal could be transported cheaply and efficiently to Hamilton by means of lake freighters. The completion of the St. Lawrence Seaway in 1959 made steel from Hamilton accessible to many foreign countries. Ocean-going ships could now easily navigate the St. Lawrence, travel to Hamilton, pick up a load of steel and travel back to the Atlantic.

In terms of rail connections, Hamilton served during the early and mid-nineteenth century as a commercial centre and port for the agricultural region of southwestern Ontario (Webber, 1983, p.1). Hamilton, for a brief period back in the 19th century, became the centre of an extensive rail network serving the southwestern part of the province. Hamilton's rail link was particularly strong in 1834 with the construction of the Great Western Railway and the location of its maintenance shops at Hamilton. Most rail links converged at Hamilton at this time. (See figure 5.) This increased accessibility gave Hamilton a great number of regional and extra-regional markets for finished goods. The iron and steel industry also felt the effect of increased rail links to Hamilton in that it could now sell its products further inland by rail as opposed to water and road traffic. Despite Hamilton losing its financial and rail importance to Toronto after 1860, the railways had nevertheless, stimulated the development of the iron and steel industry in Hamilton (Webber, 1983, p.1).

With respect to truck transportation, Hamilton is located on the Windsor-Quebec City corridor which has an extensive road system. In addition, the Queen Elizabeth Way provides direct access to New York State. Overall, Hamilton's location in the centre of the Golden Horseshoe and along the



SOURCE: W. Douglas Wells, THE HAMILTON REGION 1800 - 1882

HAMILTON RAILWAY CONNECTIONS 1882

FIGURE 5

Windsor to Quebec City Corridor ensures the rapid movement by truck of steel from Hamilton to many of the steel users within Southern Ontario, New York and Michigan States. Although accurate data on steel shipments are not available and they differ from one year to the next, it has been estimated that at least 55 percent of the production is sold in southwestern Ontario within a radius of 100 miles; about 30 percent is shipped to the rest of southern Ontario and Quebec (mainly Montreal) for sale; another 8 percent is shipped west and about 7 percent is exported (Kerr, 1967, p.143).

In dealing with labour, Hamilton is within a short distance to roughly five million Canadians. The labour force is very diversified with Stelco and Dofasco employing a large percentage of the immediate area's work force. The total employment in the Bayfront area was 45,632 in 1979. Of this Stelco and Dofasco accounted for 26,695 or 58.5 percent (Norcliffe, 1983, p.4).

While at one time Hamilton Bay could be filled in to accommodate the need of Stelco and Dofasco for more expansion space, this ended with the formal cessation of waterlot sales in 1972 (Norcliffe, 1983, p.13). During the period that infilling was allowed Stelco came to acquire some 600 acres and Dofasco 350 acres of land that had formerly been part of the Bay (Norcliffe, 1983, p.13). (See figure 6.) Hilton Works which occupies one-thousand acres on Hamilton's waterfront is bounded by Dofasco to the East, and International Harvester

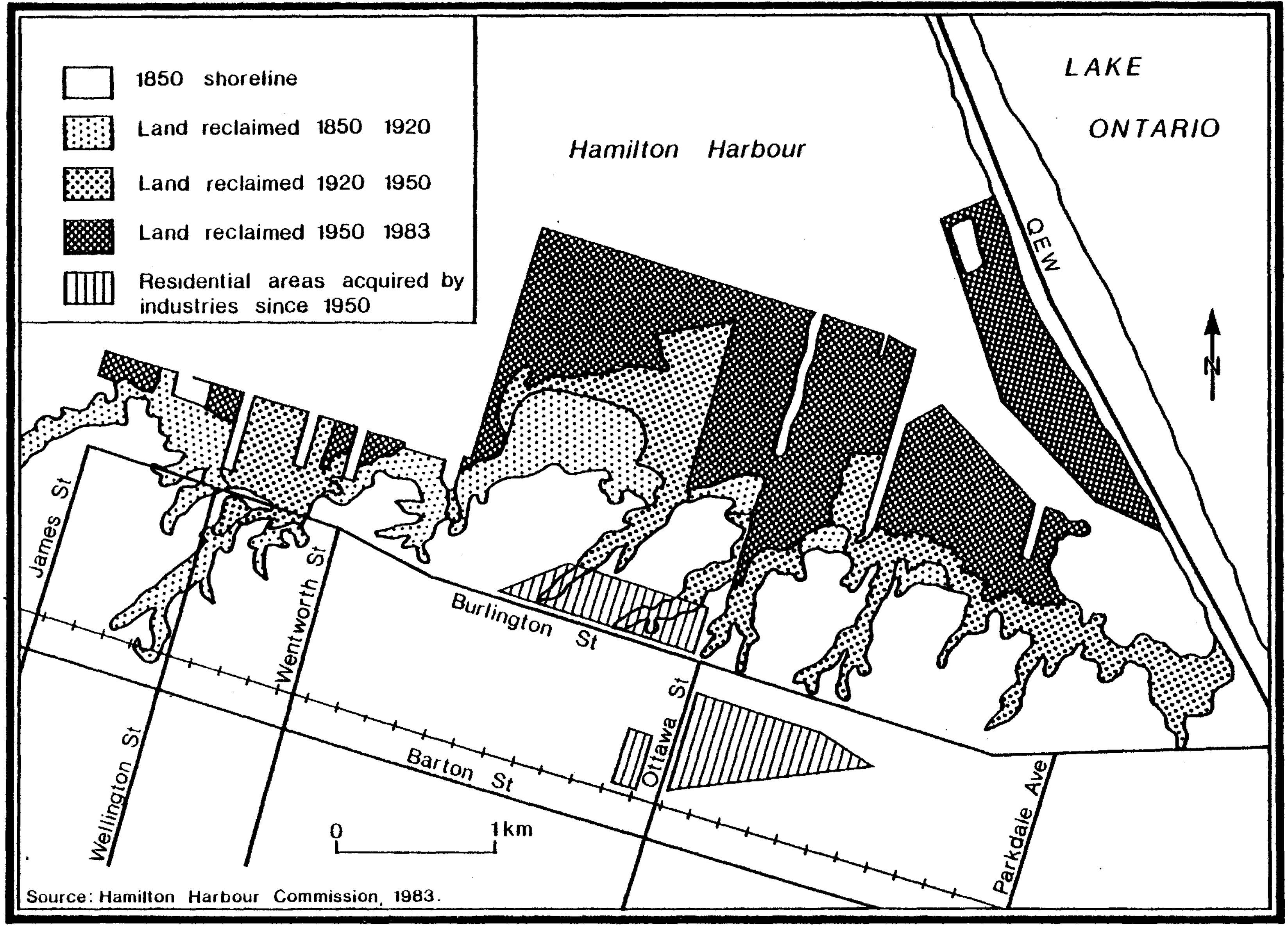

1850 shoreline
Land reclaimed 1850 1920
Land reclaimed 1920 1950
Land reclaimed 1950 1983
Residential areas acquired by industries since 1950
LAKE ONTARIO
Hamilton Harbour
QEW
N
James St
Wentworth St
Burlington St
Ottawa St
Wellington St
Barton St
Parkdale Ave
0 1km
Source: Hamilton Harbour Commission, 1983.

FIGURE 6

to the West (Webber, 1983, p.23).

Since expansion further into the Bay was impossible and land to the south was not zoned for industrial use, both Stelco and Dofasco adopted new expansion strategies by acquiring large properties in ports on the North shore of Lake Erie. Stelco acquired 6,600 acres at Nanticoke, and Dofasco has purchased land at Nanticoke and Port Burwell.

In conclusion, Hamilton's steel industry flourished because of the following factors. Firstly, economic incentives from the municipal government provided a free site, a long term exemption from taxes and a cash payment for future expansion. Secondly Hamilton's location; half-way between U.S. coal and iron ore from Labrador. Both of these raw materials can be moved quickly and efficiently by bulk carrier. An efficient road and rail network allows finished steel to be sent quickly to customers located in Southern Ontario along with New York and Michigan States. Thirdly, the completion of the St. Lawrence Seaway in 1959 opened additional markets for Hamilton steel products. Fourthly, Hamilton's location in the Golden Horseshoe is advantageous in that this region is a prime steel consuming area and has a large and diversified labour pool. Finally, the previously available large tracts of industrially zoned land encouraged both Stelco and Dofasco to expand. Since, however, this type of land is no longer available, Stelco has looked to Nanticoke and Dofasco to Port Burwell as expansion sites.

Industrial Location Theory

The purpose of this section is to discuss important concepts from Weber's industrial location theory which will prove useful in studying the location of the steel industry in Southern Ontario. In addition, case studies of steel plant location in North America will be reviewed.

Industrial location theory originated in 1909 when the German economist Alfred Weber published his first work on the subject. He attempted to show how the optimum industrial location could be found in a simple situation with two sources of material and a market represented by the corners of a triangle (Smith, 1971, p.113). (See Appendix One.) Weber's model was based on three assumptions. The first is that fuels and other raw materials are found only in some localities. The second is that the situation and size of places of consumption are given, with the market comprising a number of separate points. Conditions of perfect competition are implied, with each producer having an unlimited market and no possibility of obtaining monopolistic advantage by choice of location. The third assumption is that there are several fixed labour locations with labour immobile and in unlimited supply at a given wage rate (Smith, 1971, p.114).

In the above simplified situation transport and labour costs, along with agglomerative or deglomerative forces, influence industrial location. Transportation costs, however, are viewed as the primary determinant of plant location.

Transportation costs are considered to be a function of the weight being carried and the distance to be covered. The least-transport-cost location is the point at which the total ton miles involved in getting materials to a place of production and the finished product to the market is at a minimum. Thus, the manufacture of the product would occur at this least-cost location.

In terms of an industry being material or market orientated, Weber introduced the concept of material index for an industry. This is the ratio of the weight of the raw materials used to the weight of the finished product. A material index of greater than one indicates that a plant should locate near to the raw materials it uses, for the weight of the localized materials used exceeds the weight of the finished product. If, however, ubiquitous materials (those which are found everywhere, i.e., water) enter significantly into the manufacturing process to give the finished product a weight greater than that of the localized materials (i.e., a material index of less than one), the industry should locate at the market (Smith, 1971, p.115). When the material index is equal to one, the centre of production can be located at either the raw material or market site, or at any point between these two locations.

In dealing with labour, Weber's model allows an inexpensive labour source to divert a plant from a minimal transport cost point. This takes place if the saving in labour costs exceeds the additional transport costs incurred in the move to the lower labour cost area. If labour is important as a factor of production, (i.e., a labour intensive industry) then there exists a likelihood that the firm will seek an inexpensive labour location if within the critical isodapone (a line drawn through all those points in space that have equal total transport costs from the point of view of a given production unit) (Lloyd & Dicken, 1977, p.131). At this location the saving in labour costs compensates not locating at the least cost transport site. (See Appendix One.)

Weber deals with agglomeration activities which can have effects similar to those of labour, in that they may divert a factory from the least transport cost point. If firms that produce similar products locate close to one another, they can save by using similar services. An example of this would be the case of Stelco and Dofasco in Hamilton. (See Appendix One.) These two firms share similar markets, use the same transport infrastructure and share the same labour market. In addition their products are in joint demand from many purchasers.

Weber's theory, however, has been criticized in recent years by those who contend that his model is too much of an abstraction from the real world. As Wilfred Smith (1955) pointed out,

> "The material index provides us with a tool of analysis, but it is a blunt tool

> and is effective only at the very extremities of classification."
> (Lloyd & Dicken, 1977, p.125)

The basic problem with the material index is that it standardizes inputs and outputs as a ratio. Other criticisms relate to the notions of material index and least total cost, which are of value only in the absence of cost data (Smith, 1971, p.118). Some, however, have praised Weber's model as an excellent beginning in explaining modern industrial location theory. Isard (1956) has claimed that it was only by utilizing chiefly the Weberian approach that he could meaningfully analyze the location of the iron and steel industry in the United States (Smith, 1971, p.119). The following paragraphs will attempt to link Weber's theory to the location of iron and steel plants.

The iron and steel industry has always been highly transport oriented. The critical factor in selecting a location for a new plant is the cost of assembling the major raw materials and sending the finished product to market. While water supply, quality and quantity of land, and local taxes are important in influencing a steel plant site, easy access to high quality coking coal and iron ore still predominates.

In the eighteenth century, as much as ten tons of coal were required to smelt one ton of pig iron. Thus the need for plants to be close to supplies of coal dominated all other locational considerations (Smith, 1971, p.347).

Using Weber's model, the weight of coal was greater than the weights of the other inputs and the finished product. As technology improved in the steel industry, the quantity of coal needed to produce one ton of pig iron declined. (See figure 7.)

Figure 7

	Coal Use (tons)
Mid 18th Century	8-10
1788	7.0
1800	5.0
1840	3.5
1873	2.5
1938	1.7
1970	1.0

Tonnage of coal required to make 1 ton of pig iron in Great Britain.
Source: R.C. Riley, Multi locational Industries p.92

Perhaps the most significant technological development that resulted in a large reduction of coal used was the introduction of the hot blast in the blast furnace by Nielson in Glasgow in 1828 (Riley, 1973, p.94).

The reduction in the importance of coal, improvements in the transportation sector in the late 19th century and early 20th centuries, e.g. bulk carriers (ships, trains), and improved steel technology made it possible to produce steel with less ore and coal. In addition, the increased use of scrap, which is generated mostly in consuming areas, and higher freight rates for finished products as opposed to raw materials have shifted steel plants from raw material to market oriented locations.

Smith (1971) notes that the iron and steel industry has always been highly transport oriented. The critical element for selecting a site for iron and steel production is the cost of assembling coal and iron ore, and shipping the finished product to market. He believes that water supply, quality of land, level of local and provincial taxes and labour are important, but they are second to the transportation factor.

Smith views iron and steel plants as undergoing a gradual shift away from a raw material location to a market oriented location. Both theoretical and empirical evidence indicated that the selection of optimum locations for the iron and steel industry had become almost entirely a matter of market as opposed to a material source proximity. For example, the Ruhr in Germany and the Pittsburgh area of the United States developed when the pull of coal was great (material source) while the location of the steel industry at Hamilton and Nanticoke has been market oriented.

Smith describes a study by Isard and Cumberland in 1950 examining the feasibility of two possible locations for an integrated iron and steel plant in New England. The two possible sites were Fall River, Massachusetts and New London, Connecticut (Smith, 1971, p.352).

Their approach was to compare the two sites with other steel mills outside the region. Existing plants located at Sparrows Point (Md), Buffalo (NY), Bethleham (PA), Pittsburgh (PA), and Cleveland (Ohio) were best located to serve the New England market. In addition, Trenton (NJ) was considered since the United States Steel Corporation had already announced plans to construct an integrated works beside the Delaware River (Smith, 1971, p.352).

The market orientation hypothesis was tested by a comparative cost analysis for all the stated locations. The cost of the transportation or iron ore, coal and the finished steel products to and from the respective sites was calculated.

In all cases, ore could be obtained more inexpensively from Venezuela than from Labrador. In general, most of the cost figures were found to favour New England consumers from a New England plant. The demand factor, or the potential market, had yet to be considered. After a study of existing consumption of steel in New England, Isard and Cumberland determined there was a sufficient market to support an integrated works with an annual capacity of about 1.5 million tons. Overall, there is strong support for the market orientation hypothesis when applied to the steel industry in New England. Such a plant, however, was never located. This support is strengthened by the use of the variable-cost approach where the least-transport cost location is the point at which the total ton-miles involved in getting materials to a place of production and the finished product to the market is at a minimum (Smith, 1971, p.114). When the demand factor is introduced, with the market size corresponding to competition from other sources of supply, the strength of the market oriented hypothesis weakens. This is because of the very scale of steel making operations and agglomeration activities involved.

Casetti's (1956) study of the optimal location of steel mills serving the Quebec and Southern Ontario market also reinforces the market orientation hypothesis. Casetti bases his argument on the following trends:

1) Technological improvements have made it possible to produce steel with less ore and coal;

2) Increased use of scrap which is generated mostly in consuming areas; and

3) Higher freight rates for finished products as opposed to raw materials (Casetti, 1956, p.343).

Estall and Buchanan (1980) also deal with the location of iron and steel industry in general. Again, as with Casetti, the location at a market oriented site as opposed to a raw material oriented site takes priority.

The predominant components in the location of the iron and steel industry have been access to materials and markets, and specifically the structure of transport costs. Again, transport orientation dominates.

Prior to the emphasis on market oriented locations, access to coal, e.g. Pittsburgh and the Ruhr, and iron ore was always a primary consideration in the location of steel production. The market oriented steel plant location was partly influenced by the increasing amount of scrap being used to produce steel. The use of scrap reduces the amount of coal and iron ore used since scrap is actually refined steel and can be remelted. Consequently, with most scrap being produced in market areas, steel plants have been drawn close to this source.

The capital required to build and to operate a new modern iron and steel works is considerable. An important aspect of the investment decision in established iron and steel producing countries is that it is normally cheaper where possible to add on capacity at an existing steel installation (brownfield site) (e.g., Hilton Works) than to start anew and build an integrated steel plant at a new location. This is known as a greenfield site, e.g., Nanticoke. Stelco was forced, therefore, to adopt the greenfield site because of the fact that Hilton Works had no expansion space left.

In conclusion, this section has presented Weber's theory of industrial location and its applications to the iron and steel industry. In addition, the case studies described reinforce the current trend of steel mills locating near a market as opposed to a raw material site.

Expansion of Stelco and the Choice of Nanticoke

The purpose of this section is to briefly outline the factors affecting Stelco's decision to build their new integrated steel plant at Nanticoke. Specifically this section will deal with why expansion took place, the sites considered, and why Stelco chose Nanticoke.

In 1962, when planning was underway for the construction of an 80 inch continuous hot strip mill at Hilton Works, a serious problem came to light. While Hilton Works had space for such a facility, there was no room for the expansion of primary steel making, which was needed to supply the new strip mill. If such a facility were built, it would have created a substantial imbalance between primary steelmaking and steel rolling facilities at Hilton Works. Hilton Works could at best produce a six-million ton annual capacity, not the nine to twelve million ton capacity required to meet the marketing requirements of the next two decades (Fisher, 1974, p.2).

Stelco commissioned the management consulting firm of Arthur D. Little of Cambridge (Mass) to determine what the possible growth in steel markets across Canada would be to the year 2000. Additionally, if a new steel plant was to be constructed, where could such a greenfield development be located. Little's research concluded that the major growth of steel markets in Canada in the year 2000 would be Southern Ontario and the expansion would gravitate westward from

Toronto toward Hamilton, Kitchener, Brantford, London, and Windsor (Fisher, 1974, p.4). Secondly, it was concluded that if a new steel plant was to be built, several requirements would have to be fulfilled. First, a site comprising at least 5,000 acres, next to a major body of water with good access by road and rail and which was also reasonably close to Stelco's existing plant at Hamilton would be required. Other considerations dealt with freight rate differences for both raw materials and finished products, and the ability of the water body to accommodate deep draft ore and coal freighters. Ground conditions had to be able to support heavy steelmaking facilities and there had to be an adequate supply of labour and energy. Stelco used the above requirements as guidelines and set about finding a suitable location in Ontario.

Stelco's search came up with one location on Lake Ontario, one on Lake Huron, one on Georgian Bay, Nanticoke, plus two other locations on Lake Erie.

Stelco now had to determine which of these was the minimal cost in the economics of constructing and operating an integrated steel mill. Estimates of in-and-out shipments for the construction and ensuing operation of the proposed mill were analyzed, confirming that Nanticoke was the best location. Nanticoke, (see figure 8.) is located within the Windsor-Quebec City corridor where most of Canada's industry is located. Coal from the southeastern United States, iron

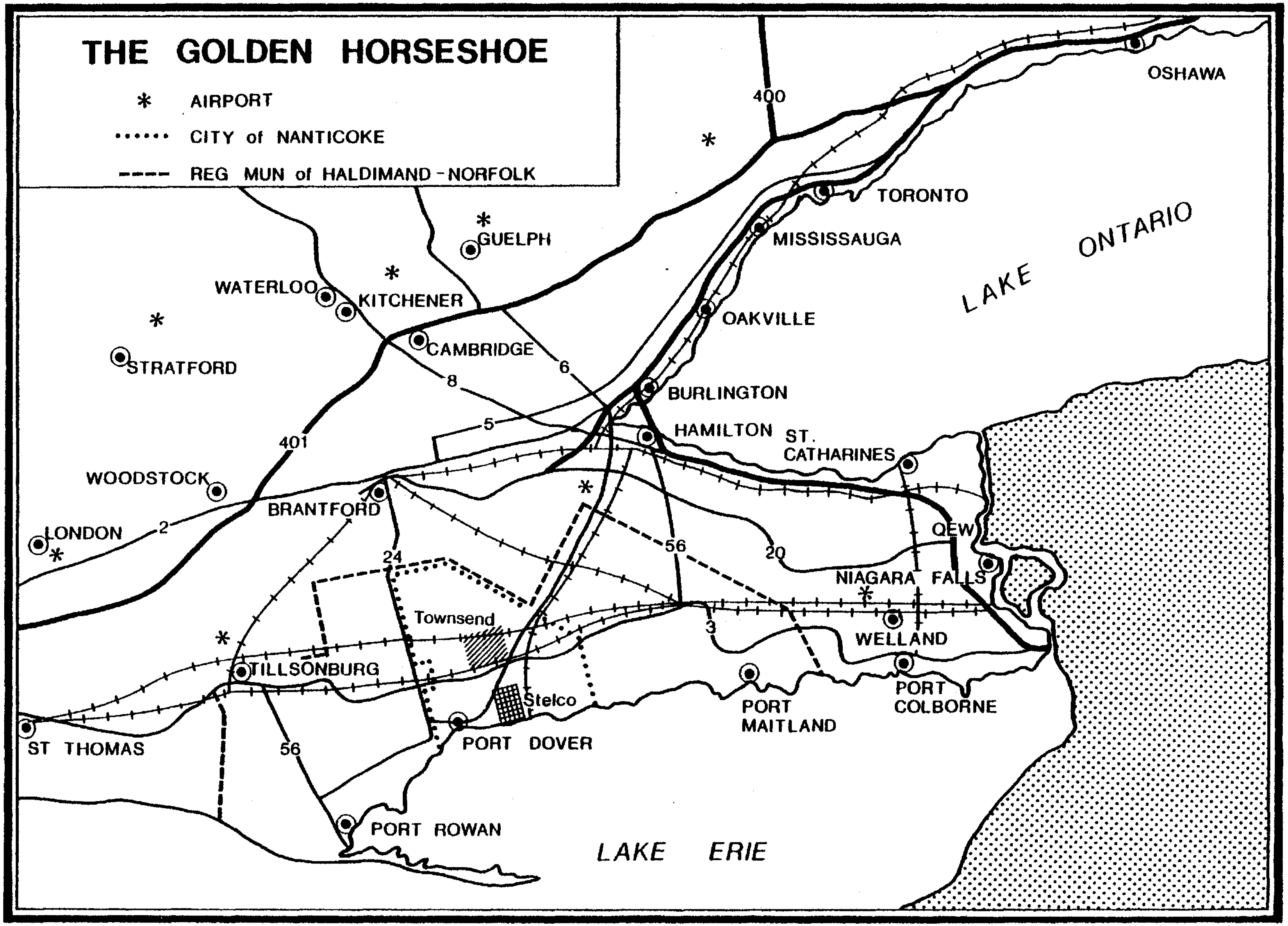

THE GOLDEN HORSESHOE
* AIRPORT
CITY of NANTICOKE
REG MUN of HALDIMAND - NORFOLK
400
OSHAWA
TORONTO
MISSISSAUGA
LAKE ONTARIO
GUELPH
WATERLOO
KITCHENER
OAKVILLE
CAMBRIDGE
STRATFORD
6
8
BURLINGTON
5
HAMILTON
ST. CATHARINES
401
WOODSTOCK
BRANTFORD
LONDON
2
56
20
QEW
24
NIAGARA FALLS
Townsend
WELLAND
3
TILLSONBURG
Stelco
PORT MAITLAND
PORT COLBORNE
ST THOMAS
56
PORT DOVER
PORT ROWAN
LAKE ERIE

FIGURE 8

ore from the Griffith Mine in northwestern Ontario and limestone from Stelco's facility at Beachville Ontario could be easily transported to the Nanticoke site. There was an abundant supply of labour available locally. The ground in this area was primarily composed of Haldimand clay and classified as marginal farmland. The clay base coupled with a good depth of bedrock posed no problem in supporting heavy steelmaking structures. The lake water depth was adequate for the handling of deep-draft iron ore and coal carriers and the shoreline was protected from adverse weather by Long Point. The shipping season at Nanticoke was four weeks longer than at other prospective locations and there was the added bonus of an Ontario Hydro thermal generating station under construction little more than a mile away (Fisher, 1974, p.5). This would ensure Stelco of a readily available and inexpensive power source for its moderate to heavy needs at Nanticoke. Nanticoke was also favoured because it involved the least amount of displacement of summer cottagers.

Stelco now moved to acquire the necessary land for its greenfield steel mill complex. Secrecy in the land buying was necessary if Stelco was to achieve a fair price. This assignment was given to one of Canada's leading real estate firms, W.H. Bosley of Toronto by Arthur D. Little without disclosing Stelco's identity (Fisher, 1974, p.6). By early 1968, Bosley had succeeded in optioning 6,600 acres of property before it became known that Stelco was behind the land buying. Stelco, however, had purchased all the required land at an average cost of $1,000 per acre (Fisher, 1974, p.6). Fully serviced land at Stelco's industrial park is now valued at between $35,000 to $45,000 per acre (Stelco, 1983, Lake Erie Industrial Park, p.14).

Construction began in 1974 and the first slab of steel at Nanticoke was produced on June 1, 1980. Appendix Two gives a detailed description of the actual steelmaking facility while Appendix Three provides a brief description of the industrial park which occupies 2,500 of the total 6,600 acres.

In conclusion, Stelco had to expand to meet the expected growth in steel consumption in Canada to the year 2000. Since no expansion space was available at Hamilton to produce the nine to twelve million annual tons needed, Stelco chose to build a greenfield site at Nanticoke on the north shore of Lake Erie.

Hamilton & Nanticoke Site Characteristics

The purpose of this final section is to show that, with the exception of available space, the differences between Hamilton and Nanticoke are negligible. By doing this, it will show that it was the space available at Nanticoke (and the lack of it at Hamilton) that influenced Stelco's decision to construct its new steel facility. Site and situational characteristics such as transportation, labour, and land will be used to assess the advantages and disadvantages of the Hamilton and Nanticoke installations.

TRANSPORTATION OF RAW MATERIALS (Limestone, Coal, Iron Ore)

Limestone is used as a flux in the blast furnace to promote the formation of slag. Limestone is trucked from Stelco's facility in Beachville Ontario to Hamilton (50 miles away) and Nanticoke (35 miles away). Costs are $4.55/NT (net ton) to Hamilton and $4.45/NT to Nanticoke (Stelco, July 25, 1983, p.1).

The coal for both Hilton and Lake Erie Works (LEW) principally comes from Stelco's Mines in Phelps, Kentucky (380 miles to Nanticoke and 480 miles to Hamilton by rail and bulk carrier) and from the Madison Mine in Ashford, West Virginia (341 miles to Nanticoke and 426 miles to Hamilton by rail and bulk carrier). Additional coal for Stelco is supplied by a few mines located in the State of Pennsylvania. Most of the coal is transported on either the Chessie or Norfolk and Western railroads. Rail and dumping costs to

Lake Erie ports are approximately $14.50 per net ton (Stelco, December 2, 1983, p.1). The water transportation rates to Stelco's facilities at Nanticoke and Hamilton are confidential. As a rough figure, however, ships carrying 25,000 tons of bulk cargo are valued at roughly $1000 per hour, with those passing through the Welland Canal incurring an additional 12 hours plus tolls (Stelco, December 2, 1983, p.1).

Therefore, Nanticoke would have a slight advantage over Hamilton in terms of coal delivery. Coal is simply loaded on bulk carriers on the south shore of Lake Erie and transported to Nanticoke on the north shore. Coal travelling to Hamilton must incur the extra time and tolls of the journey through the Welland Canal.

Iron ore for Stelco's facilities at Hamilton and Nanticoke comes from a variety of mines. The Griffith Mine, located at Red Lake, Ontario, is 100 percent owned by Stelco (Stelco Annual Report, 1982, p.7). This mine is located roughly 1200 miles from Hamilton and 1100 miles from Nanticoke. The Wabush Mines of Newfoundland and Quebec is 25.6 percent owned by Stelco (Stelco Annual Report, 1982, p.29). The Wabush Mines are located roughly 1045 miles from Hamilton and supply only that installation. These mines are an unincorporated joint venture of Stelco and other steel mills.

Other Stelco iron ore mines are the Hibbing Taconite Company of Minnesota (6.7 percent owned by Stelco and classified as an unincorporated joint venture with other steel mills) (Stelco Annual Report, 1982, p.29). The remaining iron ore mines which Stelco has interests in are classified as corporate joint ventures or partnerships with other steel mills. These are: the Tildon Iron ore Partnership (Mich), Erie Mining Company (Minn), Eveleth Expansion Company (Minn), and the Ontario Iron Company (Minn). Stelco owns 15.6, 10.0, 23.5 and 10.0 percent respectively of the above companies (Stelco Annual Report, 1982, p.29).

All iron ore is pellitized at the mine sites prior to shipment. Iron ore from the Griffith Mine is transported to Thunder Bay by truck and rail. The cost is roughly $7.96 per gross ton (Skillings Mining Review, 1983). Iron ore from the Wabush Mines is transported to Sept Iles by rail at $2.11 per gross ton (Skillings Mining Review, 1983). From Thunder Bay and Sept Iles the iron ore is transported to Hamilton and Nanticoke by bulk carrier. Stelco, unlike Dofasco, receives no iron ore by train. From Thunder Bay and Sept Iles to lake ports (i.e., Lake Erie (Nanticoke) and Hamilton) the freight rate is roughly $7.13 per gross ton by bulk carrier (Skillings Mining Review, 1983). Therefore the location of Hamilton and Nanticoke are about equal with respect to iron ore shipping costs. Iron ore travelling from Thunder Bay (Griffith Mine) to Nanticoke has to travel through only one lock at Sault Ste Marie at $100 per lock (Skillings Mining Review, 1983). If this ore travels to Hamilton, it must incur the extra time and tolls of the Welland Canal (eight locks equal $800 plus 12 hours at $1000 per hour). Wabush ore being shipped to Hamilton pays a St. Lawrence Seaway toll of $1.21 per net ton in the Montreal-Lake Ontario section (Skillings Mining Review, 1983).

Finished Products

Truck rates for outbound shipments to western Ontario and the Niagara Peninsula are about equal from Hamilton and Nanticoke. Important markets such as Toronto are about $2.00 per ton higher ex Nanticoke than Hamilton (Stelco, July 25, 1983). (Figure 9 gives a summary of transport data.)

Figure 9

	Hamilton	Nanticoke
Limestone		
From Beachville (Ont)	50 miles	35 miles
Cost	$4.55(N/T)	$4.45(N/T)
Coal		
From Phelps (Kty)	480 miles	380 miles
Cost	----	----
From Madison (WV)	426 miles	341 miles
Cost	----	----
Iron Ore		
From Wabush Mines	1045 miles	----
Cost to Sept Iles (rail)	$2.11 G/T	----
Sept Iles (bulk carrier) to	$7.13 G/T	----
St. Lawrence Seaway Toll	$1.21 N/T	----
From Griffith Mine	1200 miles	1100 miles
Cost to Thunder Bay(road & rail)	$7.96 G/T	$7.96 G/T
Thunder Bay (bulk carrier) to	$7.13 G/T	$7.13 G/T
Lock Charges	$900.00	$100.00
Finished Steel	$2.00 N/T	$2.00 N/T

Summary of transport data
N/T = Net ton G/T = Gross ton

LABOUR

The technological advantages of starting a new facility rather than upgrading or rebuilding the old are clear. The choice by Stelco to opt for a greenfield site away from their existing plant in Hamilton provided them with two significant labour relation advantages. In the first place, Stelco has, as part of its collective agreement with the Hamilton Local 1005 of the United Steelworkers of America, a condition that any technological change which causes redundancies at Hilton Works will be compensated. Consequently, to update the Hilton plant and shed labour will be costly (Webber, 1983, p.25). This agreement, however, does not cover the new Lake Erie union. Secondly, at Nanticoke Stelco reclassified job descriptions so that the Hilton Works categories of "millwright" and "electrician" are replaced by the category of "industrial mechanic" (Webber, 1983, p.25). This has enabled Stelco to acquire additional work from skilled tradesmen, while at the same time reducing the number of such tradesmen and eliminating sources of dispute between skilled workers (Webber, 1983, p.25).

A third advantage derived by Stelco at its Nanticoke operation is the lower degree of worker militancy. Of the current workforce of 1,700 at Nanticoke, 700 were drawn from Hilton Works (Webber, 1983, pp.25-26). These 700 were mainly younger workers who had been in junior positions at Hamilton and wanted the opportunity for promotion at Nanticoke. The remaining workers were from the immediate area and were never exposed to a union atmosphere, as are the majority of the industrial workers in Hamilton. In the most recent labour dispute at Stelco in 1981, Local 1005 was on strike for a record 125 days despite Stelco telling its Hamilton workers that if the strike continued, startup would see many lay-offs because of lost customers. LEW, however, were on strike less than four weeks (Webber, 1983, p.26). The militancy of the workforce translates itself into lost markets to competitors, especially Dofasco which has no union. This occurs when Stelco can not guarantee delivery during a year in which a contract must be renegotiated such as the present year. Finally, the militancy translates into wage differences: Whereas the 1981 agreement (the first since production began at Lake Erie) at the Hilton Works allowed for base rate wage increases of $1.15 per hour in the first year, $0.25 in the second and $0.30 in the third, the Lake Erie local accepted increases of $1.00, $0.15 and $0.15 respectively (Webber, 1983, p.26).

LAND

With no expansion space available at Hamilton, and Hilton Works only able to produce at most a six-million ton annual capacity, expansion was clearly needed. Of the total 6,600 acres Stelco acquired at Nanticoke the steel mill area occupies 4,100 acres (Stelco News Release, October 15, 1981).

The first stage of Stelco's LEW comprises a dock for receiving raw materials, a cokemaking facility, a blast furnace, a two-vessel basic oxygen steelmaking shop, a continuous slab casting machine and an 80 inch hot strip rolling mill (Fisher, 1975, p.3). At a cost of $829 million, stage one is producing about one million tons of steel a year (Stelco News Release, October 15, 1981).

The remaining steel mill area is more than ample to accommodate Stelco's three other stages designed to achieve a level of 5.4 million tons of annual steel production by the year 2000 (Fisher, 1975, p.5). Stage two plans propose an additional raw materials storage, a second cokemaking facility, a two-strand addition to the slab casting facility, further slab conditioning, process line additions to the hot strip finishing area, and a new integrated cold rolling and processing plant. A new plate mill and a continuous galvanizing line are also being considered for stage two (Fisher, 1975, p.5).

Stage three plans propose a raw materials handling expansion, an addition to the coke plant, and the construction of a new blast furnace. In addition, the BOF shop will be enlarged, a new two-strand slab casting unit will be installed and there will be improvements done to both the hot strip and cold mill (Fisher, 1975, p.5). Stage four will complete Stelco's program to achieve its scheduled 5.4 million ton annual capacity at Nanticoke (Fisher, 1975, p.6). Phase two, three and four were proposed during times of peak business conditions and the recent recession has altered Stelco's plans somewhat in expansion at LEW.

In conclusion, this section has shown that the overall differences between Hamilton and Nanticoke are small. Both installations are about equal with respect to coal, iron ore, and limestone supplies with Nanticoke having a slight advantage in coal and limestone transportation. Finished steel transportation rates are also about equal for the two locations. Primarily, the large tracts of land which Stelco purchased at Nanticoke has enabled it to develop an efficient steel making operation for the present and future. Such land would never have been available at Hamilton. Finally, the lower militancy of the Nanticoke workers assures Stelco of a more stable workforce than in Hamilton. The competativeness of the steel market requires constant innovation and long term commitments; local 1005's uncooperativeness on some of these issues may result in Nanticoke being the major steel producer for Stelco. Hilton Works will not be abandoned by Stelco but fine tuned to make it as efficient as possible (Spectator, January 5, 1982, p.19). At present, a public stock issue is being developed by Stelco for capital improvement at Hilton Works (Spectator, February 25, 1984, p.A8). Stelco's Hamilton plant might specialize in flat roll or bar products in the future (Spectator, January 5, 1982, p.19).

Conclusion

The location of the iron and steel industry in Southern Ontario is based on the right combinations of labour, access to raw materials and markets, transportation, and available space. Hamilton is perhaps the best example of this. The successful development of the iron and steel industry in Hamilton also stemmed from municipal government incentives. Hamilton, however, has reached its limit in terms of additional space to allow for future expansion of its iron and steel industry. Stelco realized its Hamilton installation could not be expanded beyond the existing annual six-million ton capacity. With domestic steel use expected to increase in the future, Stelco set out to find a location to develop a new integrated steel facility. After an exhaustive search, Stelco finally selected the village of Nanticoke on the north shore of Lake Erie to be the site of its future steel complex. Nanticoke met all of the necessary requirements for a steel plant, i.e., on a major body of water, good depth of bedrock and in the steel consuming area of the Golden Horseshoe. This last factor is particularly important. With the increasing cost of transporting finished products and increasing technology, steel can be produced with reduced inputs. As a result, a market as opposed to a raw material location has become the rule rather than the exception in steel plant location in recent years.

Overall, with the exception of coal and limestone which slightly favours LEW, the differences between the Hamilton and Nanticoke installations are negligible. Primarily it was the space available and the opportunity to develop new labour relations at Nanticoke that influenced Stelco's final decision.

Stelco's LEW is an industrial complex that was constructed to provide for the steel needs of Canada in the future. LEW is characterized by advanced technology and ecological concerns coexisting with minimal effect on the local environment. Stelco, through its greenbelt project and industrial park development, has ensured the preservation of the beauty of the area and the growth of the local economy.

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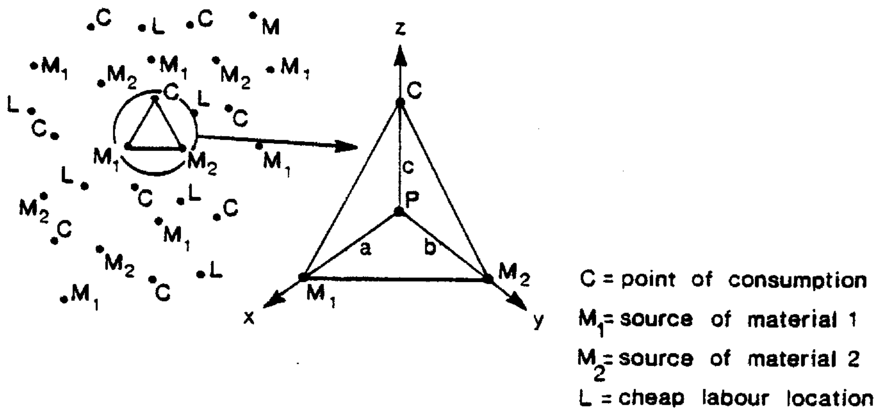

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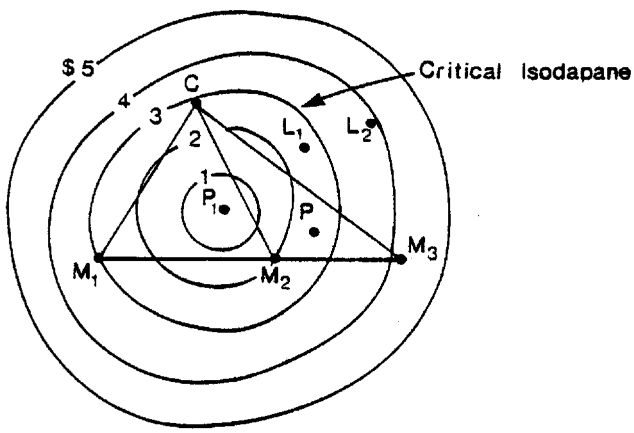

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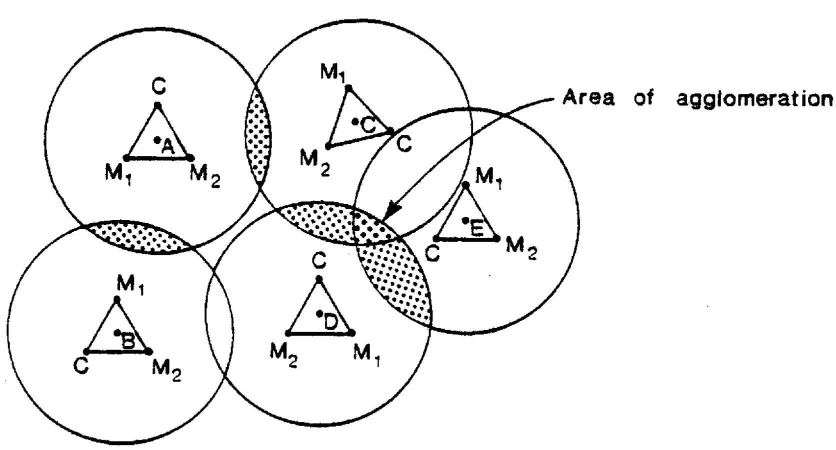

APPENDIX 1

Appendix Two

Stelco's Lake Erie Works

At Nanticoke, Stelco has developed an advanced steel making complex in harmony with the local environment. Lake Erie Works is an industrial complex which has combined technology and ecological concerns to produce an integrated steel plant second to none in the world. This section will focus on the technical layout of the plant along with the ecological aspects Stelco has successfully dealt with.

Since Stelco was starting off new at Nanticoke, it had the rare opportunity among steel firms to develop a layout geared toward an efficient movement of raw materials and steel in the various stages of production. This is always a major concern and cost in every steelmaking venture. Planners at LEW developed a south-to-north materials flow, with the limited use of railways. Railways tend to hinder the movement of materials within the plant as well as restricting future expansion. Large rubber tired vehicles are used in place of railways as the principal means of transporting materials within the complex (Stelco, 1980, Lake Erie Works, p.4).

Production of steel at LEW begins at the dock located at the southeastern corner of Stelco's property. The dock extends 4,000 feet into Lake Erie and will accommodate self unloading freighters carrying coal and iron ore pellets (Heneault, June 16, 1980, p.9). A steel and concrete bridge extends 1,000 feet from shore which joins to a 1,500 foot rock filled causeway which extends to a 1,500 foot unloading wharf (Fisher, April 3, 1975, p.3). Iron ore and coal as it is being unloaded, travels along a one-and-one half mile long continuous conveyor belt. This belt is powered by three 1,000 horsepower electric motors and is capable of handling 11,000 tons of ore or 5,000 tons of coal an hour (Heneault, June 16, 1980, p.10). The dock is designed so that fish and small boats can travel under the bridge near the shore, and the conveyor is covered to prevent dust blow off. Once the ore and coal reaches shore it is transfered by conveyor and stacker crane to the raw material storage compound. The coal piles are shaped and sprayed with water to reduce dust blow off during periods of high wind.

Coal is then blended and transported to the coke ovens by conveyor. Here coal is baked in air tight ovens for roughly seventeen hours to produce coke which is used as a source of fuel in the blast furnace. LEW has forty-five coke ovens each of which is twenty-two feet high. They are the tallest structures of their type in North America (Heneault, June 16, 1980, p.10). LEW coke ovens feature under fired heating using a combination fuel system. Other features consist of a moveable hood which captures and cleans emissions during coke pushing and following transportation in the quench station (Stelco, News Release, October 15, 1981). A coke oven by-products station will recover light oils, tar and anhydrous ammonia which is used in fertilizer production.

Coke, iron ore, and limestone are now transported to the blast furnace where liquid iron is produced. LEW's blast furnace is one of the most impressive and modern in North America. The blast furnace features a computerized stockhouse to ensure the right mixes are provided to produce different types of steel. Other features of the blast furnace include: Three Dutch-designed (Hoogovens) stoves which provide a hot air blast temperature of 1205^{c} which is the highest in North America (Iron and Steel International, August 1979, p.227); Liquid fuel injection; a stove cooling system developed in the U.S.S.R.; and a rotating distributor for charging materials (Paul Wruth top) (Fisher, April 3, 1975, p.4). In addition the casthouse features a fugitive emission control system and the tilting runners over the hot metal cars being covered with removable hoods (Stelco, News Release, October 15, 1981, p.2). The blast furnace has a potential daily capacity of 5,300 tons (Fisher, April 3, 1975, p.4).

The liquid iron produced by the blast furnace is then transported to the basic oxygen furnace (BOF) by special refractory lined railway tank cars; torpedo cars. At the BOF the molton iron and scrap is charged into one of two 250 ton vessels (Heneault, June 16, 1980, p.11).

Once the vessel is charged with iron and scrap, it is turned upright and high purity oxygen is blown through the top. This burns impure and unwanted elements out of the charge, converting it to steel. One heat of steel can be produced in forty minutes. (A heat being a quantity of steel produced) (Fisher, January 21, 1975, p.7). Waste gases produced during the blowing of oxygen through the charge will be recovered by an "OG" system developed by Nippon Steel of Japan. This system consists of a moveable hood which is lowered over the mouth of the BOF during the blowing of oxygen. These gases are collected, cleaned and can be used as a source of fuel elsewhere in the plant (Fisher, November 18, 1974, p.13).

The ladle of molten steel is now transferred to the pouring isle by crane which places it on one of two arms of the turret assembly of the continuous casting system. Continuous casting, unlike the traditional ingot form adds 10 to 12 percent more yield of steel from the molten form as there is no trimming of ends involved (Spectator, September 16, 1980, p.11b). The molten steel flows from the ladle into a reservoir called a tundish, then into vertically oscillating, water-cooled copper molds. Moving downward, the molten steel gradually solidifies and emerges as slabs of steel. Solid steel slabs, up to 10 inches thick, 32 feet in length and 74 inches wide can be produced (Fisher, January 21, 1975, p.7). Steel slabs are cut to desired lengths by a travelling torch.

The slabs are then transported to the hot strip mill to be produced into hot strip coils. First the steel slabs are reheated in a computer controlled furnace to predetermined temperatures ranging from 2000° to 2400° F (Stelco, Annual Report, 1982, p.15). After the slab emerges from the reheat furnace, high pressure water jets remove surface scale. Then it enters a reversing stand powered by a 12,000 horsepower main drive, with a close coupled 3,000 horsepower edger (Fisher, April 3, 1975, p.5). After several passes the slab is reduced to about one inch in thickness. Now called a transfer bar, the hot steel enters the coilbox where it is coiled to retain heat. The coilbox was invented by Stelco engineer Bill Smith and permits the movement of transfer bars between the roughing and finishing stands. The coilbox chief advantages are that it saves energy as more heat is retained in the coil, and allows for the production of wide light gauge products without the requirement of a long and expensive mill. The transfer bar is then uncoiled, and sent to the cropshear where the head and tail of the bar are removed. This bar is now fed into the four finishing stands where the final reduction takes place. Computer controlled cooling beds ensure a fine grain metallurgical structure within the strip. Downcoiling takes place on a removeable mandrel coiler accurately matched to rolling speeds and finishing temperature requirements

(Stelco, Annual Report, 1982, p.16). Finally, a walking beam off loading conveyor provides a damage free coil for storage or shipment.

From the beginning, Stelco has emphasized strict environmental controls at its LEW. The objective was to preserve the aesthetics of the area by an extensive greenbelt project. The greenbelt project was undertaken on a half-mile-wide slice of land along the east side of the property, plus a wide section between the lake and steel site (Stelco, News Release, October 15, 1981).

Contoured earthmounds, or earth berms, were created and planted with grasses, bushes, and trees to form a visual screen. These earth berms also provided a noise buffer and barrier to diminish the effect of wind blown pollutants. The east-side of the greenbelt was provided with small settling ponds to trap any contaminated run-off water.

The planting of grass, flowering shrubs, and trees began in 1973 and more than 75,000 trees had been planted by 1981 (Stelco, News Release, October 15, 1981). This planting not only has added to the beauty of the area, but preserved existing woodlots. About 350 acres have been set aside for conservation and environmental purposes in the industrial park site (Stelco, News Release, October 15, 1981).

Water quality is maintained at a high standard due to all of the manufacturing facilities at LEW having closed recirculation systems. In fact more than 90 percent of the water used for steelmaking purposes will be recirculated (Stelco, News Release, October 15, 1981). LEW does not even have its own water intake, but is provided with water and sewage facilities by the Ministry of the Environment.

In conclusion, Stelco at LEW developed an efficient south to north operation. Coal and iron ore enter from the dock located at the south of the property and finished steel emerges from the north. (See figure 10.) The most advanced technological equipment and processes were used by Stelco at LEW which has resulted in a highly productive plant. (See LEW Statistics, figure 11.) Environmental concerns were dealt successfully by the installation of effective pollution control devices and methods at all stages of production. Finally, Stelco's greenbelt development has shown to the world that the old view of a steel plant polluting the air and water and being a physical scar on the landscape is no longer true.

EW: the materials flow

stelco

[cut off], Stage One capacity: 1.17 million t
Total site area: 2670 ha (6600 acres)
Steel plant area: 1660 ha (4100 acres)
[cut off]ustrial Park area: 1010 ha (2500 acres)
[cut off]oundbreaking: May 1974
[cut off]ck length: 1190 m

Conveyor capacity (eventual):
10 000 t ore/hr 4500 t coal/hr
Raw materials storage capacity:
1 060 000 t coal 860 000 t ore
Coke oven length: 16.4 m
Coke oven height: 6.7 m

Coke oven width: 470 mm
Coke oven capacity: 522 000 tpy (17 hr cy)
Coke ovens, number: 45
Blast furnace preheat (stoves): 1200°C (ultimate)
Blast furnace capacity: 2722 t/day (current)
4764 t/day (ultimate)

BOF shell diameter: 6150 mm
BOF vessel capacity: 230 t
BOSC area: 23 000 m²
BOSC height: 82 m
Maximum slab thickness:
240 mm (current) 300 mm (ultimate)

Maximum slab width: 1880 mm
Maximum slab length: 12.2 m
Maximum slab weight: 36.3 t
LEW cost, Stage One: $829 million
Major engineering drawings: 15 200
Current workforce: 1000 (approx.)

LEW workhours, Stage One:
5.4 million, engineering
10.2 million, construction
Construction commenced: November 1974
Trees planted: 75 000
Environmental costs: $94 million

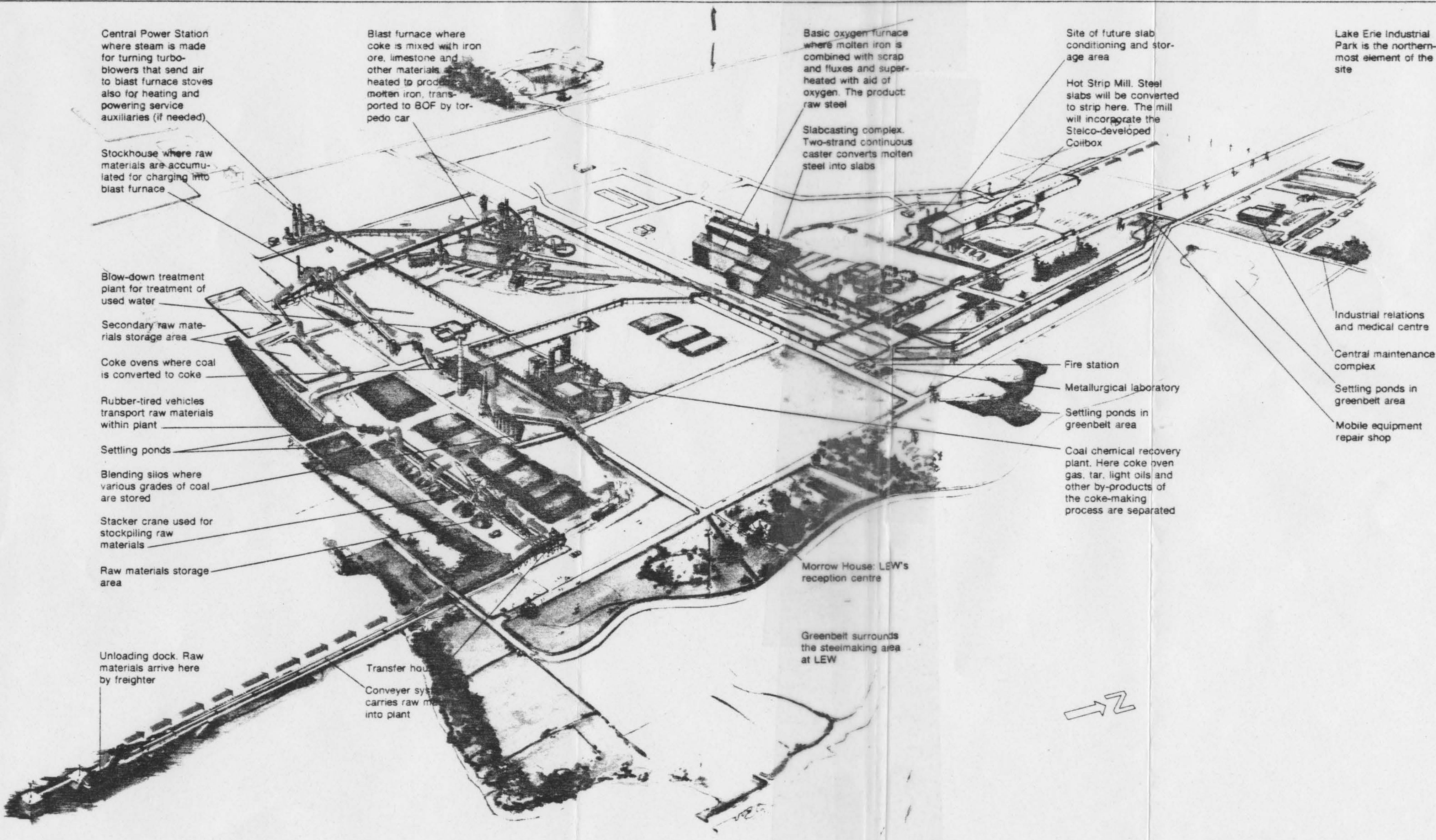

Figure 11

LEW, Stage One Capacity 1.17 million tons

Total site area 6600 acres
Steel mill area 4100 acres
Industrial Park area 2500 acres
Open, greenspace areas comprise approximately 10 percent of total

Rock length 4000 feet
Conveyor length 1.2 miles
Conveyor Capacity (eventual)
10,000 tons of ore/hour
4500 tons of coal/hour
Lake freighter length
220 meters (722 feet) current
305 meters (1000 feet) eventual
Raw material piles
Coal 9 meters (30 feet)
Iron Ore 21 meters (70.4 feet)

Coke Oven, length 16.4m (53 feet)
height 6.7m (22 feet)
Coke Oven Capacity is 522,000 tons per year based on a 17 hour coking cycle
Number of Coke Ovens 45
Blast Furnace Preheat Stoves
1205°C (ultimate)
Blast furnace capacity
2994 tons a day (current)
5240 tons a day (ultimate)

BOF shell diameter 6150mm (21 feet)

BOSC Area 23,000m^2
BOSC Height 82m (270 feet)
Vessel Capacity 230 tons
Structural Steel Content 40,315 tons

Maximum Slab thickness
240 mm (10 inches) current
300 mm (12 inches) ultimate
Maximum Slab width 1880 mm (6.2 feet)
Mamimum Slab length 12.2 m (40 feet)
Maximum Slab weight 36.3 tons

Stage One Cost $829 million

Stage One manhours
5.4 million (engineering)
10.2 million (construction)
12 million (suppliers on and off site fabrication)
Major Contracts Awarded 500+
Major engineering drawings prepared 15,200
Present on site workforce 1700

Stage One groundbreaking May 1974

Construction began November 1974
Trees planted 75,000
Environmental costs $94 million
Topsoil removed 910000 m^3
90% of water recirculated

Lake Erie Works Statistics
(revised August 15, 1980)

Source: Stelco News Release October 15, 1981

Appendix Three

Lake Erie Industrial Park

At LEW Stelco has developed a 2,500 acre industrial park in the northern portion of its site (Stelco, 1980, Lake Erie Works, p.6). Stelco undertook such a development for three major reasons. First, there are advantages to be gained by having steel suppliers and steel mill users located close by. Secondly, an industrial park allows for the development of secondary and service activities which can contribute to the overall economy of the local area. Finally, the industrial park has substantial environmental importance and is a significant part in the ecological approach at LEW. This section will provide a brief description of the park and its advantages with regards to location, transportation, labour, energy supplies, taxes, water and sewers and financial inducements and government assistance.

Of the total 2,500 acre site, only about 1,850 acres will be used for industrial and commercial purposes, 350 acres will be set aside for conservation and environmental purposes, while the remaining 300 acres will be used to supply utility corridors (Fisher, April 3, 1975, p.6). Price per fully serviced acre ranges from $35,000 to $45,000 (Stelco, 1983, Lake Erie Industrial Park, p.14). The first phase of the park incorporates 332 marketable acres which can accommodate both light and heavy industry. At present, Marsh Engineering Ltd, (Machine Shop), Air Products Ltd, (industrial gases and supplier of oxygen to the BOF), Riverside Refractories (fire brick), Nelson Steel (steel coil processing centre) and Charles Jones Industrial Ltd (industrial supplies) have located within the industrial park (Stelco, January 25, 1984).

Stelco, being the major force behind the development, requires tenants who wish to locate within the industrial park sign covenants which will ensure that the character of the park stays as Stelco planners designed it (Spectator, September 16, 1980, p.6b). To keep out land speculators, Stelco requires the purchaser to develop the property within a specific time period. Under the initial sale agreement, Stelco can buy back the property and assess a cash penalty on the purchaser if he does not develop the lot (Spectator, September 16, 1980, p.6b).

Stelco's industrial park is located in Canada's industrial heartland -- The Golden Horseshoe of Southern Ontario. The park is only forty-five minutes from Hamilton and an hour and a half from Toronto (Advantages and opportunities for industry in Nanticoke, (AON), 1983, p.2). U.S. markets of Buffalo and Detroit are readily accessible by truck while Cleveland and Pittsburgh are directly south across Lake Erie.

The industrial park is adequately serviced by an efficient road, rail, air, and port network. Provincial Highway 3 runs east-west through the City of Nanticoke and provides cross-province access in southwestern Ontario. This highway also provides Nanticoke with connections to Buffalo and Detroit. Provincial Highway 6 provides Nanticoke with north-south access and is a major link to Hamilton and Toronto.

Canadian National Railways (CNR) operates an east-west route through Nanticoke linking Buffalo, St. Thomas, London, Windsor and Detroit. The CNR also operates another line linking Nanticoke with Hamilton and Toronto (AON, 1983, p.5). The CNR in conjunction with Canadian Pacific (CP) have instituted a servicing agreement for the industrial park. This will allow for the provision of extensive rail development in the fore mentioned utility corridors as the park develops. Con Rail as well operates a line through Nanticoke connecting Buffalo and Detroit.

Regarding air services, Mount Hope Airport is located only twenty minutes from Nanticoke and offers flights to Pittsburgh, Ottawa, Montreal and Windsor/Detroit. In addition, a $50 million expansion will soon provide additional services (AON, 1983, p.6). Pearson (Toronto) International is only an hour and a half from Nanticoke and offers full international and customs services. Air services are also available at a smaller scale at London, Tillsonburg, St. Catharines, St. Thomas, Kitchener-Waterloo, and Welland.

Full scale port facilities are available at Toronto, Hamilton and Windsor. Port Colborne, about a half an hour from Nanticoke has limited port handling facilities. (i.e., Grain, Flour) Plans, however, are presently being finalized for a $50 million dock complex at Port Maitland (AON, 1983, p.7).

Labour of skilled, unskilled technical and professional form are all readily available and within a short commuting distance to Nanticoke. Lower labour costs also characterize the Nanticoke area. In 1979, average hourly pay for workers in industrial production was lower than in Illinois, Michigan, New Jersey, New York, Ohio, and Pennsylvania. Wages are also lower in comparison to Hamilton (AON, 1983, p.12).

Energy supplies at Stelco's LEW are assured by Ontario Hydro's 4000 megawatt Nanticoke thermal generating station located only a half mile away from the industrial park (AON, 1983, p.13). Electrical service is available in the 500kv and 230kv range with unlimited capacity (Lake Erie Industrial Park, 1983, p.15). Rates for electricity are comparable, if not better than in the U.S. or other major industrial countries. Natural gas supply is provided by a large volume high-pressure distribution main which is capable of providing the needs of industrial park customers. In addition to natural gas, other industrial gases such as oxygen, nitrogen, and argon are available from Air Products Ltd. The Texaco refinery which is located close by can also provide a wide range of fuel and lubricant products.

Realty taxes in Nanticoke are approximately 20 percent lower than major centres of southwestern Ontario (AON, 1983, p.15). As a percentage of book profits for manufacturing companies, Ontario's corporate income tax is 31.9 percent compared with 37.6 percent for Texas, 41.3 percent for Ohio and 43.1 percent for New York (AON, 1983, p.15). In Ontario, the tax depreciation rate is 50 percent straight line, while in the United States it is 20 percent, (declining balance) (AON, 1983, p.15).

Industrial park users are provided with all the necessary water and sewage facilities to ensure trouble free operation. A feeder main from the Regional Water Purification Plant at Lake Erie provides water to the industrial users. Charges for the water are low and all the pumping and purification systems are of recent construction. Each lot on the industrial park is connected to municipal water, sewage and storm drainage systems.

The Province of Ontario, always willing to help business set up and prosper within its boundaries, offers programs to assist location. Term loans can be made available to firms wishing to locate or expand in Ontario. The Province also makes available excellent consultant services to potential firms. Also, financial incentives and grant programs are available for firms specializing in research and development.

In conclusion, the industrial park concept developed by Stelco at Lake Erie is designed to help the growth of the local economy. Secondary and service activities locating within the industrial park can take advantage of immediate accessability to steel, fuel and lubricants (Texaco) and cheap power (Ontario Hydro). Finally, the park is completely serviced and has attractive advantages relating to location, transportation, labour, infrastructure and government support.