Feasibility Analysis
OF A
RURAL ECO-INDUSTRIAL PARK
IN
PERRY COUNTY, ILLINOIS

University of Southern California Center for Economic Development

August 2005

This report was prepared for the Perry County Economic Development Department
under an award from the
Delta Regional Authority as administered by the U.S. Department of Agriculture

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The Feasibility Analysis of a Rural Eco-Industrial Park in Perry County was prepared for the Perry County Economic Development Department under the auspices of Leonard Mitchell, Esq., Executive Director: USC Center for Economic Development, School of Policy, Planning, and Development, University of Southern California.

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I. EXECUTIVE SUMMARY

This study developed a practical eco-industrial park model for the 528-acre industrially zoned land owned by Midwest Transload adjacent to Pyramid State Park known as the Midwest Transload site and provides recommendations for its development. Research was conducted on three components of the eco-industrial park: the availability and dependability of solid waste arriving by rail, the costs and benefits of constructing a materials recovery facility (MRF), and the mix of businesses offering long-term quality employment in an eco-industrial park compatible with the available waste stream.

Waste hauling by rail will become more feasible as local landfill solutions become more and more limited in a 200-500 mile radius of the Perry Ridge Landfill. The tipping fees in target markets must exceed the tipping fees at the regional landfill by the per ton transportation cost for rail options to become attractive. At this time those numbers do not support rail hauling of waste from St. Louis or Chicago. However, waste is currently trucked in from nearby counties and states with recyclables included that can be collected at a materials recovery facility at the Midwest Transload site.

Perry Ridge Landfill's contract with the county includes a material recovery facility/ transfer station that will allow the county to reach the 25% recycling rate goal set by the state. In addition it will create new jobs and provide feedstock for businesses in the eco-industrial park. Trucks headed for the Perry Ridge Landfill can stop at the materials recycling facility to have their waste sorted to remove recyclables. The remaining waste material can be consolidated in transfer trucks reducing traffic at the landfill. Tipping fees are reduced for the recyclables in the load thereby reducing the overall cost of dumping at the Perry Ridge Landfill. This in turn will increase the attractiveness of Perry Ridge to haulers.

Processed recyclables will either be sold as commodities or sold to co-located businesses on the Midwest Transload site that will use them as raw materials in their manufacturing

process. Because the site has very little infrastructure today, developing infrastructure that is compatible both with the adjacent state park and the targeted businesses is essential. One requirement is for waste water treatment. The Living Machine™ is a waste water treatment system that can treat water from residential, commercial, or industrial uses producing clean water and biosolids. Waste water flows through a series of tanks containing different groups of bacteria, algae, snails, plants, fish and other organisms that decompose, eat, and grow on the material in the water until the water is pure enough to be recycled. The treated water is often used for non-potable uses such as flushing toilets, landscape irrigation, or coolant towers. Restorers may be of interest to the state park, which are floating water purifiers used in lakes or ponds utilizing the technology of the Living Machine™.

In order to attract a mix of businesses offering long-term quality employment, an environmental eco-industrial business park is proposed for the Midwest Transload site which we are calling the Pyramid Environmental Business Park. Some of the businesses will require additional infrastructure such as power, water, or waste water treatment to locate on the site. For this discussion, those needs are assumed to be met providing additional incentives to prospective tenants.

Tenants that may be attracted more easily include the railcar repair and storage businesses, the corn-based ethanol plant, concrete building material manufacturer, and corn starch biodegradable plastic manufacturer because one of their prime inputs is already located in the region. With the addition of the materials recovery facility, the glass tile manufacturer, composting operation, and other recycled material manufacturers will be interested in locating on site to be near one of their prime inputs. The Living Machine™ waste water treatment plant should be planned into the growth of the park and the need for waste water treatment. With its addition to the site, the site becomes attractive to an aquaculture (fish farm) or aquaponics (fish and hydroponic plant farm) operation.

Table 1 summarizes the material and water exchanges between proposed tenants of the eco-industrial business park.

Table 1: Pyramid Environmental Business Park

Business	Local Input	Received From	Output	Potential Users
Material Recovery Facility	Municipal Solid Waste Stream	City/County Solid Waste Pick-up	Organic Waste, Glass Cullet, Green Waste, Paper, and Wood	Tenants shown in table
Concrete Building Material Manufacturer	Fly Ash, Crushed Concrete, Glass Cullet	Power Plant, C&D, MRF	Waste water	Living Machine™
			Waste	Perry Ridge Landfill
Glass Tile Manufacturer	Glass Cullet (Mixed Glass)	MRF	Filtered Waste Water	Fish Farm
Composting Operation	Organic Waste	MRF	Compost	Local Farmers and Households
Other Recycled Material Manufacturer	Sorted, Processed Recyclable	MRF, waste processer	Waste water	Living Machine™
Living Machine™ Waste Water Treatment Plant	Waste Water	Tenants, Perry Ridge Landfill	Purified Water	Landscaping, Tenants
Fish Farm or Aquaponics	Purified Water	Living Machine™	Waste Water	Living Machine™
	Organic Waste, Distillers Grain	MRF	Fish and Plant Waste	Composting Operation
Corn Starch Biodegradable Plastic	Corn Starch	Local Farmers	Waste water	Living Machine™
Corn-Based Ethanol Plant	Corn	Local Farmers	Distillers Grain	Aquaculture
			CO_2	Aquaponic Greenhouses
Railcar Repair	Railcars	Railcar owners	Mixed waste	MRF or Perry Ridge Landfill
Railcar Storage	Railcars	Railcar owners, local businesses	Minimal mixed waste	MRF or Perry Ridge Landfill

II. BACKGROUND

The University of Southern California Center for Economic Development (Center) through the National Center for Eco-Industrial Development (NCEID) facilitates job creation and sustainable industrial expansion in distressed communities around the nation by applying principles of industrial ecology, establishing eco-industrial parks, and expanding use of environmentally benign manufacturing processes and techniques. On July 31, 2002 a workshop was presented to stakeholders in Perry County to discuss the possibility of developing an eco-industrial park on the 528 acre industrially zoned land owned by Midwest Transload adjacent to Pyramid State Park. The Center and NCEID were then engaged to analyze the feasibility of developing a rural eco-industrial park utilizing the combined industrial and business opportunities related to the landfill and the Midwest Transload site given its proximity to Pyramid State Park, including the rail transloading business. A model for a rural eco-industrial park was to be developed utilizing data collected by the county on current business opportunities at the Midwest Transload site, the local industry profile, and local workforce profile.

The advantages of this particular site include its proximity to a new landfill, the 141-acre Perry Ridge Landfill, direct access to two major rail networks, 14.5 miles of rail lines advantageous for unit train transloading and repair, and a large garage/repair shop. Opportunities will be analyzed for synergistic business development between the landfill and business area, such as constructing a material recovery facility and the attraction and/or development of businesses utilizing the recycled materials. Further analysis will include the business use and reuse of bulk commodities related to the transloading operation.

This report summarizes the research undertaken and recommendations for next steps in the development of an environmental eco-industrial park at the Midwest Transload site.

III. OBJECTIVES AND PURPOSE OF THE PROJECT

This report summarizes the Center's findings regarding the feasibility of developing a rural eco-industrial park utilizing the combined industrial and business opportunities related to the landfill and the Midwest Transload site adjacent to Pyramid State Park, including the rail transloading business. The three objectives of the feasibility analysis were to determine the availability and dependability of solid waste arriving by rail, the costs and benefits of constructing a materials recycling facility, and the mix of businesses offering long-term quality employment in an eco-industrial park compatible with the available waste stream.

A. Study Approach

The project team, made up of Master of Planning candidates and graduate research assistants, supervised by Center staff, followed a systematic approach: collecting data, assessing viability and summarizing information. To guide the team through the project, a comprehensive work plan was developed which provided the background strategy and framework for the methodical tracking of requirements from the overall objectives. This work plan is described below.

Task 1 - Investigate the rail market potential of the business area.

- Identify potential commodities that might be transported in or out of the site by rail and/or otherwise used in the production process locally.
- Assess feasibility of waste hauling by rail both for recycling operations at the business area and for dumping at the Perry Ridge Landfill.
- Analyze the possibility of hauling out coal, grain, and fertilizer in unit trains that have dropped off a load of waste and the impact on the feasibility of recycling operations. Rail companies only permit un-bound solid waste in special flatbed rail cars (unless solid waste is bailed).
- Identify new business opportunities that complement existing operations in an eco-industrial context.

Task 2 – Feasibility analysis of a material recycling facility located on the business area and utilization and re-utilization of bulk commodities.

- Identification of the types and quantities of potential waste stream(s) that could flow to the Perry Ridge Landfill via rail to the business area and factors affecting the dependability of the flow.
- Identification of the uses of recycled materials that would serve as prospective feedstock to other tenants of the business area.
- Identification of the prospective job creation of a material recycling facility.
- Calculation of initial capital costs of a material recycling facility.
- Identification of design and/or operational considerations of a material recycling facility compatible with the surrounding Pyramid State Park.
- Identification of bulk commodities that could be transloaded on site.
- Analyze the potential uses of bulk commodities as prospective feedstock for park.
- Identification of the prospective job creation of the utilization and re-utilization of bulk commodities

Task 3 – Development of a practical eco-industrial park model for the business area. Prepare report with results and recommendations.

- Identify business uses for recycled materials generated by the material recycling facility.
- Identify mix of businesses in resource recovery industries in Perry County.
- Identify potential material exchanges among facilities where materials generated as waste or non-product outputs from one facility could be used to meet the material input requirements of another facility.
- Identify optimal combinations of businesses in resource recovery clusters that have strong ties to the area - regional users - as well as export markets.

IV. FINDINGS OF THE STUDY

Our recommendations for next steps in the development of an environmental eco-industrial park at the Midwest Transload site are summarized in Table 2. Because the existing quantity of recyclable materials from the local municipal solid waste stream will not support a fully integrated eco-industrial park on the Midwest Transload site today, our recommendations begin with expansion of existing operations. In addition, there are opportunities available for businesses engaged in eco-industrial business practices that will form the nucleus of an evolving eco-industrial park. As the waste stream increases so will the opportunities for eco-industrial relationships and green businesses.

The matrix in Table 2 identifies recommended economic development strategies and implementation steps for the short-, medium-, and long-term. Strategies that can be implemented immediately rely on a prime input that is already located in the region:

- Expand existing transloading operations
- Recruit railcar storage and repair businesses
- Recruit a corn-based ethanol plant
- Recruit a concrete building material manufacturer utilizing fly ash
- Recruit a corn starch biodegradable plastic manufacturer

With the addition of the Materials Recovery Facility the following manufacturers will have access to a ready supply of a prime input for their manufacturing process:

- Glass tile manufacturer
- Composting operation
- Other recycled material manufacturers

The Living Machine™ waste water treatment plant should be planned into the growth of the park and the need for waste water treatment. With its addition to the site, the site becomes attractive to an aquaculture (fish farm) or aquaponics (fish and hydroponic plant farm) operation.

Table 2: Recommended Strategies for the Midwest Transload Site

Economic Development Strategies	Implementation			Comments
	Short-term	Medium-term	Long-term	
Expand Transloading Business	Coal	Local Crops, Fly ash, Plastics	Biodegradable Plastic, Municipal Solid Waste	Begin conversation with City of Chicago for waste-by-rail hauling now.
Build the GERE Materials Recovery Facility (MRF) on Site	Negotiate with GERE	Construct MRF	Recruit recycled manufacturers	GERE's contract includes a Materials Recovery Facility.
Recruit Railcar Storage Facility	Contact railcar users about their storage needs	Contact large shippers re: site	Construct warehouses for storage	
Recruit Railcar Repair Facility	Contact operators in state re: site	Negotiate with an operator		Look for operator experiencing pressure from urban development.
Recruit Ethanol Manufacturer	Contact producers in state re: site	Negotiate with a producer	Add or convert to cellulosic-based production	Start with corn-based. Add or convert to cellulosic-based when technology becomes available.
Establish "Green" Principles for Site	Discuss with site owners	Develop "Green" Principles Goals	Market site as "Green" Business Park	See models in resources section at the end of report: Devens, Cape Charles, Codes, Covenants and Restrictions
Recruit Concrete Building Material Manufacturer (fly ash)	Contact existing manufacturers	Determine infrastructure needs	Negotiate with an operator	For more info: http://www.greenbuilder.com/sourcebook/Flyash.html
Recruit Biodegradable Plastic Manufacturer	Contact existing manufacturers	Determine infrastructure needs	Negotiate with an operator	For more info: http://www.bpiworld.org/BPI-Public
Recruit Glass Tile Manufacturer	Contact existing manufacturers	Determine infrastructure needs	Negotiate with an operator	See resources section.
Recruit Composting Operation	Identify potential public and private users of compost	Determine whether facility will be public or private	Recruit operator and build facility adjacent to MRF	For more info: http://www.compostingcouncil.org/index.cfm
Recruit Aquaponics or Fish Farming Operation	Visit successful operators	Identify markets for fish and plants	Negotiate with an operator	Partner with Southern Illinois University at Carbondale to identify high-margin products
Build Living Machine™ Waste Water Treatment Plant	Visit existing facilities	Discuss treatment needs w/ designer	Build treatment plant	Pilot treatment plant technology through use of lake restorers on a strip mine lake.

A. Short-term Implementation Steps - Comments

Expand Transloading Business

In June 2005 the Chicago City Council passed an ordinance banning the expansion or siting of new landfills in the city for the next 20 years. Waste-by-rail can take ten years to plan, design, and implement. Now is the time to contact the City of Chicago Department of Environment to discuss their plans for the future of waste disposal in Chicago.

Build the GERE Materials Recovery Facility (MRF) on Site

The owner of Perry Ridge Landfill, GERE, agreed to build and operate a materials recovery facility/transfer station as part of its contract to provide waste services to Perry County. Locating this facility on the Midwest Transload site creates additional jobs through the co-location of recycling businesses. Negotiations with GERE should be initiated for development of the facility.

Recruit Railcar Storage or Repair Facility

Railcar storage or repair facilities require inexpensive land for their operations. Rail use isn't expanding at a pace to warrant additional support facilities. However, existing facilities may be experiencing pressure from urbanization. The Midwest Transload site possesses facilities that would allow an existing business to relocate and allow their former site to be redeveloped.

Recruit Ethanol Manufacturer

Use of ethanol is expanding and corn is locally available. As the technology is commercialized for the production of cellulosic-based ethanol, additional lines can be added to process sugars from the cellulose. Corn stover could be used from the local farmers. Corn starch will still be in demand for production of biodegradable plastics.

Establish "Green" Principles for Site

As a marketing strategy for the site and to target businesses that would be compatible with the neighboring Pyramid State Park, we recommend the adoption of "Green" principles. Examples of similar business parks are Devens in Massachusetts, and Cape Charles Sustainable Technology Park in South Carolina. A model Codes, Covenants, and Restrictions for eco-industrial parks was developed by the Cornell University Work and Environment Initiative.

Recruit Concrete Building Material (fly ash), Biodegradable Plastic, Glass Tile manufacturers or a Composting Operation

Information on existing manufacturers is provided to assist in the recruitment of businesses. Prospective tenants can be identified by attending conferences and product shows.

Recruit Aquaponics or Fish Farming Operation

Low temperatures in Perry County mean that greenhouses are necessary to have year-round plant and fish farming operations. High-margin products are therefore necessary to cover the cost of the additional infrastructure. Southern Illinois University at Carbondale Fisheries and Illinois Aquaculture Center and Office of Economic and Regional Development can help identify the right fish and plants and business plan for this business.

Build Living Machine™ Waste Water Treatment Plant

There are several operating Living Machine™ waste water treatment plants that can be visited to view the effectiveness of the technology. A local demonstration of the technology is available by installing a Restorer on one of the lakes in Pyramid State Park.

V. SUMMARY OF INFORMATION COLLECTED

Task 1: Rail Market Potential: Solid Waste and Bulk Commodities

A. Background

The Midwest Transload site contains 14.5 miles of rail lines and existing transloading and trucking operations and lies 10 miles from the recently opened Perry Ridge Landfill. The rail lines access both the Union Pacific Railroad (Union Pacific) and the Canadian National-Illinois Central (CN) rail lines. Union Pacific is an operating subsidiary of Union Pacific Corporation. It is the largest railroad in North America, operating throughout the western two-thirds of the United States.[1] Union Pacific also interchanges traffic with the CN rail system. CN operates the largest rail network in Canada and the only transcontinental network in North America.[2]

Figure 1: Union Pacific Rail Network

Source: http://www.uprr.com/aboutup/maps/sysmap/index.shtml, Union Pacific Website

[1] www.up.com
[2] www.cn.ca

VI. Potential Commodities Transported by Rail

Transportation of commodities throughout the nation is vital to the survival of the economy. The nation's ports, rail routes, and transloading facilities keep the economy and revenue flowing. Planners consider transportation a key element to community development. How well or how poor the infrastructure of a state, county or city is connected by transportation becomes central to improving local business opportunities. Table 1 lists the distance and travel time for goods in transit to selected major cities.

Table 3: Distance and Travel Time for Goods in Transit to Selected Major Cities

City	Highway Miles	Highway KM	Days By Rail	Days By Truck
Atlanta	479	766	3	1
Chicago	310	496	2	1
Cleveland	558	893	3	1
Dallas	667	1,067	3	2
Denver	932	1,491	5	2
Detroit	547	875	2	1
Kansas City	326	522	3	1
Los Angeles	1,888	3,021	5	4
Memphis	242	387	2	1
Minneapolis	700	1,120	3	2
New Orleans	661	1,058	3	2
New York	989	1,582	5	2
St. Louis	69	110	1	1
Seattle	2,4146	3,434	5	4

Source: http://www.ci.pinckneyville.il.us/ecdev_demo.shtml

A. Coal

Coal is one of the largest commodities exported from Perry County. Phoenix Energy Resources LLC west of DuQuoin and Knight Hawk Coal, LLC (Knight Hawk) on the Jackson/Perry County line produce 44,178 tons and 2,500,00 tons of coal, respectively. All coal is transported by truck or rail outside the county. Knight Hawk trucks coal from its mines to Midwest Transload for distribution via unit trains. The owner of Knight Hawk just opened a mine called the Prairie Eagle mine near Cutler, Illinois immediately west and somewhat north of the Midwest Transload site. This new mine is expected to produce 4,000,000 tons per year.

B. Fly Ash

Fly ash is the finely divided residue that results from the combustion of pulverized coal and is transported from the combustion chamber by exhaust gases.[3] It is a by-product produced by coal-fired electric and steam generating plants. 160,000 tons of alkaline fly ash is being transported by Midwest Transload from Canada for use in the manufacture of paint.

C. Agricultural Products

The majority of the crops produced locally consist of corn, soybeans and wheat. Rail is an efficient way to distribute these agricultural commodities.

D. Plastics

Plastics exhibit strong characteristics as a commodity for rail hauling. Business Facilities, a national site selection magazine established in 1968, published a ranking of states in February 2000 to discover where the growth in the plastics industry has occurred and what factors have contributed to it. Illinois was ranked #3, factors included that one third of the nation's gross domestic product is produced within 300 miles of Illinois, half within 500 miles and 20% of the cost of plastic raw materials is the cost of transportation.

E. Municipal Solid Waste

Given the proximity and capacity of Perry Ridge Landfill, municipal solid waste (MSW) is a potential commodity for hauling from the urban centers like Chicago or St. Louis. Perry Ridge currently receives 150-200 tons per day of MSW but has the capacity to receive 1,900 tons per day.

F. Construction and Demolition Debris

Construction and demolition (C&D) debris represents one subgroup of waste for rail hauling. C&D consists of concrete, asphalt, wood, gypsum, scrap metals and glass.

[3] Fly Ash Facts for Highway Engineers, U.S. Department of Transportation Federal Highway Administration, http://www.fhwa.dot.gov/pavement/recycling/fach01.cfm

C&D debris is usually disposed in two types of landfills. According to the *Solid Waste Digest*, 48% of all excess C&D debris is dumped at Municipal Solid Waste landfills. 49% of the same type of debris is dumped at landfills designated for construction debris.[4]

VII. Feasibility of Waste by Rail Hauling

Waste hauling will become more feasible as local landfill solutions become more and more limited in a 200-500 mile radius of the Perry Ridge Landfill. The tipping fees in target markets must exceed the tipping fees at the regional landfill by the per ton transportation cost for rail options to become attractive. At this time those numbers do not support rail hauling of waste from St. Louis or Chicago.

A. Hauling Solid Waste by Rail: History and Problems

To lay the foundation for the analysis, the history of hauling municipal solid waste (MSW) by rail are examined along with the barriers that currently hinder waste transportation by rail throughout the United States. In the 1980s and early 1990s, transportation of waste by rail showed great promise as the future of waste delivery. In the mid-1990s, volume was predicted to grow from 1 million tons of municipal solid waste (MSW) to 25 to 30 million tons per year. The long-term potential of rail was speculated to capture 15-20 percent of the waste transportation market in North America.[5] Unfortunately, the bullish projections of the last decade have not been realized as the process continues to be stalled by problems associated with the coordination of delivery, cost, social and political constraints.

1. Coordination of Delivery

There are three key requirements for making waste by rail economical and efficient: 1) full trains, 2) full containers, and 3) direct routes. Rail usually works best when hauling large quantities (200+ tons per day) for long distances (200+ miles) with heavy products (1,300+ pounds per cubic yard). Hauling waste by rail is not a simple operation. Garbage trucks need to collect and deliver waste to a centralized processing facility large enough to stockpile huge volumes of MSW. From there, the waste requires complex

[4] Chartwell Information. As C&D Waste Piles Up, Governments Take Different Paths to Recovery. *Solid Waste Digest.* Volume 13, Number 7-8. July/August 2003. http://wasteinfo.com. Obtained November 11, 2004

[5] Aquino, John. "Has Railhaul Finally: Made the Turn?" Waste Age. May 1, 1999.

sorting, processing, and preparation before it can be loaded into an intermodal waste container that is specially designed to contain odor and debris. The containers are transferred to a dedicated unit train routed to another transfer point or remote landfill. Once the waste reaches its final destination, the intermodal waste containers are offloaded by specialized equipment and trucked to the landfill or materials recovery facility where the tipping fee[6] is paid. The empty containers are then returned to the train so the process can begin again. Moreover, throughout the entire procedure, scheduling and transfer complexity are vulnerable to external factors such as local regulations and permissible hours of operation. The process of rail-hauling waste requires a tremendous amount of organization and planning in order for it to be successful.[7]

2. Cost Issues

Compared with trucking, rail operations involve significantly more capital expenses. The majority of costs are tied up in leasing rail cars, intermodal waste containers, and the equipment needed to transfer MSW. As a result, transporting waste by rail imposes operators with significant upfront costs. The additional fixed costs present a price barrier in comparison with the lower variable costs associated with trucking waste. In order to overcome these issues, rail must transport large volumes of waste and from a high priced disposal market (usually large urban areas with high local disposal costs) to a low priced disposal market (usually rural areas with low local disposal costs).

The cost disparity between the exporting region and the importing region accounts for the major economic incentive to ship waste by rail. In reference to this price differential, the data seems to indicate that tipping fees need to be above $50 per ton in the originating disposal market to consider rail as a viable option. That figure will be higher in some markets as it is dependent upon the cost of alternative waste disposal options. In order to lower rail costs, efforts must be made to streamline operations, pack more waste per container, utilize new technologies, and speed up the loading and unloading process.

[6] Tipping fee = fee charged for waste disposal service, usually a per ton charge collected upon delivery to disposal site

[7] Merrill, Lynn. "Rail Haul: Making Tracks or Destination Unknown?" Waste Age. June 1, 1996.

Any efficiency in the process will beneficially affect the economics of the waste by rail hauling operation.

3. Social/Political Constraints

For rail hauling to become a viable option, one must also consider the problems associated with transporting waste throughout various regions. While moving waste across state boundaries has increased during the last 10 years, local public opinion is not favorable when municipalities become another state's dumping grounds. There are emotional and environmental impacts on communities who become destinations for waste. While there may be significant economic benefits for the community, they are rarely articulated clearly.[8] As a result, it may be hard to gather the political and public support needed to establish a successful rail haul operation.

In summary, there is currently not a strong demand for utilizing rail as an option to transport waste. Solid Waste Digest explains, "The glut disposal capacity from the mid 1990s is still excessive relative to steadily growing demand. Intense competition along with recent economic downturn continues to keep disposal fees relatively low."[9] As long as competition continues to keep disposal fees low there will be less economic incentive for companies to use long haul rail waste disposal.

Over time, hauling waste-by-rail will become a necessity in markets with shortages of waste intake and high tipping fees. There are a number of communities across the nation that are anticipating the future and the need for importing accessing waste. The map in Figure 2 shows industrial, waste-to-energy, landfill, and transfer facilities that are

[8] Solid Waste Digest. "Ten Years After Supreme Court Rulings, Interstate Waste Issue Still Unresolved?" February 2002.
[9] Solid Waste Digest. "The State-of-the-Industry for Hauling Waste by Rail: Change is on The Horizon." 2003.

Figure 2: Waste Disposal Facilities With or Planning Rail Access

Source: Chartwell Information, a division of Environmental Business International, Inc., SPECIAL REPORT: Waste-by-Rail The State-of-the-Industry for Hauling Waste by Rail: Change is on The Horizon, ISSUE: Volume 13, Number 6, 2003

currently utilizing rail for importing and exporting waste or are planning to utilize rail sometime in the future.

B. Benefits and Feasibility of Hauling Waste by Rail

Despite all the problems associated with hauling waste by rail, there is a potential to make the process work. Properly planned rail operations could realize benefits immediately if employed in appropriate markets. Tom Young, of HDR Engineering, explains that "as landfills near urban areas begin to reach their permitted capacities, tip fees will potentially rise, and cities will most likely begin to collaborate with the private sector to develop the infrastructure needed to move waste over longer distances."[10] It seems clear that rail haul operations will become a necessity in those markets most plagued by capacity shortages, resulting in high local disposal costs.

Shipping waste by rail is also the safest, most environmentally conscious and economic manner in which to move materials over long distances. David Kerr, Western Canada Landfill Sales Manager, explains, "Rail is one of the safest methods of transportation.

[10] Merrill, Lynn. "BFI Asks: Truck or Train?" January 1, 1999.

When you are shipping rail to rail, there is no chance of cross-contamination."[11] Other benefits include getting tractor-trailer trucks off interstates, which reduce the risk of accidents, lowers the impact on highway infrastructure, and reduces air pollution. Table 3 compares the pros and cons of hauling waste by rail.

Table 4: Pros and Cons of Waste By Rail

WASTE-BY-RAIL	
PROS	**CONS**
● Projects can be initiated within 9 months once permits are obtained and sufficient waste streams are identified ● Waste-by-Rail minimizes traffic (truck) congestion on interstate and city roads ●Waste-by-Rail is more reliable when considering weather and other external factors ● Transferring Waste-by-Rail is safer because there are less chances for accidents ● Using rail lessens the impacts on local and regional infrastructure, therefore lessening the cost of repairing infrastructure ● Rail reduces the amount of air pollution output ● Transfers more waste at the same time ● Potential to produce more jobs and revenue at receiving end	● NIMBYism – shipping one counties waste problems to another county ● Projects take too long to initiate and permit ● Difficulty getting the railroads to participate/commit ● Financing for rail use is difficult ● Some jurisdictions find that hauling waste-by-rail is too expensive ● Variations in weight, density, and types of cars/containers causes problems when not properly planned ● Complex contract arrangements made between generators, haulers, and disposal site

Source: Compiled from articles on Waste by Rail (see bibliography)

[11] Solid Waste Digest. "The State-of-the-Industry for Hauling Waste by Rail: Change is on The Horizon." 2003.

1. Case Study – Lee County Landfill, South Carolina

In 1997, South Carolina took in approximately 400,000 tons of out-of-state MSW. By 2000, South Carolina accepted more than 1 million tons of out-of-state waste. The staggering increase was a result of waste coming in via rail to the Lee County Landfill. Since 2000, Lee County Landfill has become South Carolina's largest operating landfill. Privately run by Allied Waste Industries (Allied Waste), the landfill accepts up to 1.27 million tons of trash a year. The bulk of the waste comes from northern eastern states where landfill space is at a premium.[12]

Allied Waste is one of the nation's largest waste disposal firms, operating 340 collection sites and 1480 transfer stations in 42 states. In this case, the company utilizes its network of landfills and transfer stations to take advantage of the price differential of disposal between northeastern states and Lee County (high priced disposal market to a low cost disposal market). In New York, New Jersey and Massachusetts, tipping fees can cost anywhere from $70 to $100 per ton, greater than the local tipping fee in South Carolina of $20 per ton.

The revenue from Allied Waste's operations has had a positive effect on the rural South Carolina community. The county, with approximately 1/3 of its residents below the poverty level, receives $1 for every ton buried in the landfill, which totals over $1 million a year (based on 2000 estimates). By comparison, the county's budget in 2000 was around $7 million a year. Allied Waste also saves the county each year by providing free pickup and trash disposal. Moreover, the company spent $8 million to upgrade the local railroad track for waste hauling, which has allowed the county to recruit industries that would not have been able to use the old rail lines for their operations.[13]

[12] Monk, John. "Northern States Sending Garbage to S.C. Megadump." Garden State EnviroNet (www.gsenet.org) July 10, 2000.
[13] Ibid.

Since the increase in waste disposal, the county has recently seized another opportunity to benefit from the operations at the Lee County Landfill. In July 2004, officials reached an agreement to generate electricity from methane gas produced by decaying waste at the landfill. The methane gas will be used to fuel a $7 million generating station that the state-owned electric and water utility will construct, own and operate at the site. Allied Waste will sell the methane gas and will lease property to build the facility. The generation station will be capable of producing 5.4 megawatts when it enters into commercial operation. The landfill takes advantage of the growing concept of "green power" electricity. This process is an example of "green power" because the methane gas is a renewable form of energy and it reduces the amount of greenhouse gases emitted in the environment.[14]

C. Feasibility for Perry County

Hauling waste by rail via the Midwest Transload site to the Perry Ridge Landfill will require upfront investment which will in turn require cash flows from hauling contracts that repay the investment and offer a reasonable return. In order for hauling contracts to become available for waste-by rail, the following circumstances will need to be in place:

- Landfill capacity in large urban market(s) is limited
- Tipping fees in large urban market(s) are greater than $50/ton
- A large contract is available for bidding and a suitable staging area is identified for processing the MSW for transport via rail utilizing intermodal containers
- Intermodal containers are transferred to truck for final leg to Perry Ridge Landfill where the contents are dumped
- OR if right-of-way is available, lay a short spur line to landfill site

An interview with Frank Willman at WasteByRail, a subsidiary of Waste Management, identified issues to consider with a landfill that is 10 miles away from a railroad staging area. He said it requires an "over-all economic analysis to determine if this would be cost-effective. It depends on what material is being shipped, where the material is coming from, and the alternative disposal site options available." Laying rail from the

[14] Press Release. "Santee Cooper's Methane Gas-to-Electricity Generating Equipment Arrives in Lee County." July 30, 2004.

Midwest Transload site would again be determined by the over-all economic analysis "to determine if the capital cost for construction of the rail line can be recovered. If it is a long term project, the answer may very well be yes. If it is a short term project, the answer probably would be no." He also said, "Usually recyclables are recovered before shipment so that you are not paying additional transportation costs on recyclables." When asked for a rule of thumb on tipping fee cost differential he replied, "There is no rule of thumb. It all depends on the cost of the alternatives."

One of the alternatives to Perry Ridge Landfill is the Cottonwood Hills Landfill, 35 miles to the northwest. As the following case study points out, waste by rail is not yet economically feasible within this market area.

1. Case Study – Cottonwood Hills Landfill, Marissa, Illinois

Cottonwood Hills Landfill is located 35 miles away from the Midwest Transload site via Union Pacific rail line. It is operated by WasteByRail, a Waste Management subsidiary founded in June 2000 to offer creative solutions to solve complex solid waste transportation and disposal challenges for municipalities, large industrial companies, environmental firms and other commercial customers. The company provides solid waste generators access to the largest number of diverse and specialized landfills in the country for economical disposal of solid waste. They have developed strategic partnerships in the transportation industry to offer efficient long haul rail transportation through various transportation and disposal sites.[15]

During Cottonwood Hills' first year of operation the landfill received 4,220 tons of MSW. Of the waste collected, only 27% came from out-of-state (Missouri). In the second year of operation, the amount of waste accepted grew to 284,906 tons. Of the waste collected, 65% came from out-of-state (Missouri). In 2002, the landfill accepted 313,879 tons of waste, with 67% from out-of-state (Missouri, Arkansas, and Kentucky).

[15] www.wastebyrail.com

In 2003, 384,638 tons of waste was accepted, with 75% from out-of-state (Missouri, Arkansas, and Kentucky).[16]

Although the landfill is sited adjacent to a rail line, all of this waste is trucked in. The infrastructure for waste by rail has not been installed because they have not yet generated a contract for hauling waste by rail to fund the development of a railspur and unloading facilities for the delivered waste. The cost of hauling waste by rail to Perry Ridge Landfill is greater than that needed for Cottonwood Hills due to the 10 mile distance from the rail lines at Midwest Transload.

2. Next Steps

Tipping fees in the Chicago Metropolitan Region should be monitored to determine when to reconsider waste by rail. According to the Environmental Protection Agency's Seventeenth Annual Landfill Capacity Report, the Chicago Metropolitan Region had only five years of landfill capacity remaining at the end of 2003.[17] As the region's landfills continue to approach capacity, other disposal options will be required. Sometime in the future, tipping fees in the Chicago region may support a waste by rail operation at the Midwest Transload site. Most waste-by-rail projects take between five and seven years to bring on line; now is the time to initiate a conversation with the waste management department with the City of Chicago.

VIII. Unit Trains Hauling Waste In, Commodities Out

There are cases of cost savings in transportation through hauling loads each way instead of empty cars. For the Midwest Transload site, this requires matching waste exporting markets with commodity importing markets and cleaning the rail cars sufficient for re-use without contamination. Because waste hauling in not yet feasible, matching commodity matches is not yet needed.

MSW and C&D are most often transported via intermodal containers. Intermodal containers would allow collection via truck from numerous locations for delivery to an

[16] Illinois Environmental Protection Agency, Sixteenth Annual Capacity Report – 2002 and Seventeenth Annual Capacity Report – 2003
[17] Ibid.

intermodal facility for shipping to the Midwest Transload site. They can be single or double stacked along with other products for shipment. Trucks picking up intermodal containers will drop off empty ones for refilling (see Figure 3).

Figure 3: Intermodal Container

Source: WasteByRail, http://www.wastebyrail.com/services.asp

IX. Business Opportunities

The following business opportunities have been identified that would complement existing operations in an eco-industrial setting: production of pavers, bricks or other concrete building materials using locally produced fly ash, ethanol production using corn now and corn stover or MSW in the future, materials recovery facility to sort MSW being trucked to Perry Ridge Landfill which would provide additional raw materials, compost from food waste and yard trimmings, fish farming, and a railcar repair facility utilizing the existing rail lines on site.

A. Pavers, Bricks or other Concrete Building Materials

The fly ash byproduct from the two nearby coal burning energy plants can be used for a new business that manufactures construction materials such as pavers, bricks or other concrete building materials. When fly ash is used in concrete with Portland cement it improves many of the properties of the concrete.

Using coal fly ash can conserve energy by reducing the demand for typical pavement materials such as lime, cement and crushed stone, which take energy to produce. Each

ton of fly ash used to replace a ton of cement, for example, saves the equivalent of nearly one barrel of imported oil and saves the landfill space it would have occupied if not put to use. Also less greenhouse gases are produced that would otherwise contribute to global warming. Every ton of ash reused in cement products equates to nearly a ton of CO2 savings. Coal fly ash can also replace clay, sand, limestone and gravel, and save the energy costs of mining such materials.[18]

B. Ethanol, Distillers Grain, and Carbon Dioxide

The Midwest Transload site is well situated for an ethanol plant; it's close to the current and future feedstocks and has rail connection for delivering the product to market. California is a new large market for ethanol as a replacement for the gasoline additive MTBE. Rail has been shown to be the best alternative for shipment from small plants at less than 80 million gallons production capacity.[19]

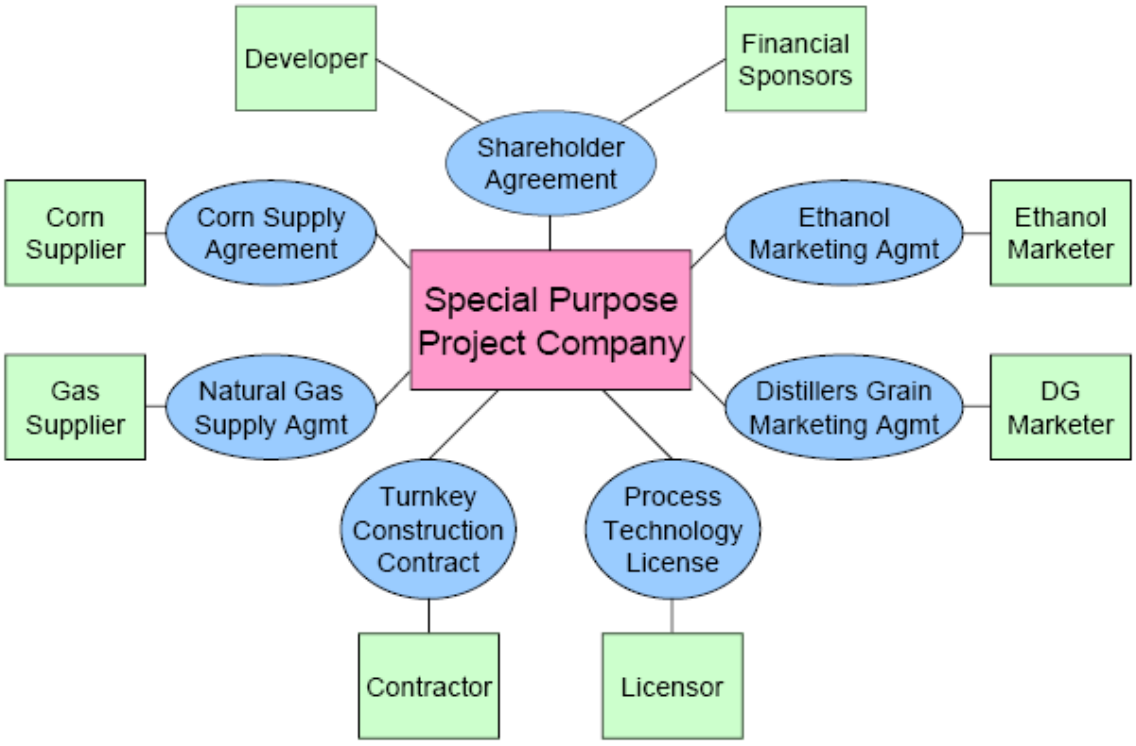
There are 90 ethanol plants currently operating in the U.S.; six are located in Illinois. Five of those plants collectively produce 50% of all ethanol in the U.S.[20] These plants use corn to produce ethanol. However, the future of ethanol production is with cellulose-based feedstocks such as corn stalks or stover and municipal solid waste. Several companies are being supported by the U.S. Department of Energy in developing technologies for reducing the cost of producing ethanol from biomass and/or municipal solid waste. As these new technologies become commercially tested and available, the corn-based ethanol plant sited today could be converted to corn stover or MSW-based ethanol.

Ethanol is used today as a gasoline volume extender, an oxygenate for high-oxygen fuels in California, an oxygenate in reformulated gasoline in some markets, and has potential as a fuel in flexible-fuel vehicles. The current increases in gasoline prices if they continue will also affect the market for ethanol as its success has been due in large part to

[18] The Fly Ash Resource Center, http://www.geocities.com/CapeCanaveral/Launchpad/2095/flyash.html
[19] Downstream Alternatives, Inc., *The Use of Ethanol in California Clean Burning Gasoline: Ethanol Supply/Demand and Logistics* (Bremen, IN, May 1999).
[20] Illinois Corn, http://www.ilcorn.org/Education/Ethanol_Fastback/fstfacts/fstfacts.html

the federal ethanol subsidy. That subsidy is due to expire in 2008, and its renewal will depend upon the degree of political support and or need for the subsidy. If ethanol becomes competitive due to the increase in gasoline prices, the subsidy may no longer be needed to support the market.

Figure 4: Ethanol Plant Project Structure



Source: Successfully Siting and Financing an Ethanol Plant, Todd E. Alexander http://www.abanet.org/environ/committees/renewableenergy/teleconarchives/092105/Todd.pdf

Figure 4 diagrams the typical project structure of an ethanol plant. In addition to producing ethanol, a byproduct of the corn-based process is distillers grain which is combined with the evaporated liquid byproduct to make distillers dried grains with solubles (DDGS) for use as an animal feed. The average yield per bushel of corn is 2.7 gallons of ethanol and 18 pounds of DDGS.

Another byproduct of ethanol production is carbon dioxide. It is a harder market to break into. In 2001, only 16 ethanol plants were recovering and selling their carbon dioxide. It

is captured in a liquid state. For each million gallons of annual ethanol capacity, 8 tons of liquid carbon dioxide is generated daily.[21] Ideally, in an eco-industrial context, a carbon dioxide processing company would co-locate to serve the local market and St. Louis.

C. Materials Recovery Facility

A materials recovery facility either at the Midwest Transload site or the Perry Ridge Landfill site sorting recyclables out of the unsorted municipal solid waste stream would produce a large volume of recyclables for processing. Those materials would either be sold and transported out of the region or used locally to generate new businesses manufacturing new goods from the recycled materials. Once the Perry Ridge Landfill attains a daily flow of 1,000 tons the recyclables should constitute roughly 100 tons/day of plastic, 50 tons/day of glass, 75 tons of metals and 600 tons of cellulosic waste (paper, food, wood, yard trimmings). According to the American Plastics Council, the demand for recycled PET and HDPE plastic exceeds supply and the midwest has the largest number of plastics recycling facilities.

D. Composting

Composting is the controlled microbial decomposition of organic matter, such as food and yard wastes, in the presence of oxygen, into humus, a soil-like material. Yard trimmings and food residuals together constitute 23 percent of the U.S. municipal solid waste stream. When composted, those materials serve as a valuable soil amendment that could be used by local farmers in place of fertilizer or by coal strip mines to restore the land after mining operations. In addition to reducing the amount of material disposed of in landfills, compost can promote higher yields of agricultural crops, reduce or eliminate the need for chemical fertilizers, and suppress plant diseases and pests.[22]

There are no composting facilities in Perry County. As of the most recent Annual Landfill Capacity Reports (2003), New Earth, in Williamson County was the only composting facility operating in Southern Illinois. That year they reported handling

[21] 2001 Ethanol Plant Development Handbook, 3rd Edition, BBI International, p. 98.
[22] U.S. EPA website: Composting, http://www.epa.gov/epaoswer/non-hw/composting/index.htm

1,557 tons of landscape waste, an increase of 47% over the previous year. The report also points out that the tonnage processed is negligible compared to the amount of municipal waste sent to landfills in the region. A composting operation in Perry County adjacent to the proposed Materials Recovery Facility would increase the likelihood of receiving raw materials. To be successful it will require markets for selling the compost.

E. Aquaculture or Fish Farming

The State of Illinois invested $7 million in aquaculture or fish farming between 1999 and 2003 to establish the Illinois Fish Farmers Co-op to provide a fish processing plant in Pinkneyville for the farmers' catfish as well as technical assistance to the farmers. Unfortunately, in 2003 the bottom fell out of the catfish market and the processing plant was closed and funding ceased. As a result, the aquaculture industry in Southern Illinois will have to grow based on entrepreneurial talent and aquaculture experience.

Resources that still exist are to be found at Southern Illinois University at Carbondale. The Fisheries and Illinois Aquaculture Center conducts research and the Rural Enterprise and Alternative Agricultural Development Initiative (READI) promoted aquaculture as rural enterprise development. Although the READI project has also wound down, their website contains information useful for starting a fish farming venture in catfish, striped bass or prawns.

The Midwest Transload site could provide rail access to markets for fresh fish farmed in Perry County or could provide space for a more intense operation using indoor tanks. Anyone considering an aquaculture operation in Perry County will need to have experience and a business plan flexible enough o respond to changes in the market, but could benefit from synergies available through an eco-industrial development on the Midwest Transload site.

F. Railcar Repair Facility or Storage

The rail lines on the Midwest Transload site are ideal for a certified railcar repair facility. As this is a mature industry, current railcar repair facilities are likely to be the initial point of contact for siting such a facility at this location. A larger operator may be interested in

consolidating their operations at this location due to the access it provides to both the Union Pacific Railroad and the Canadian National-Illinois Central rail lines. One large operator with facilities in southern Illinois is Rescar. There is also a listing of repair services on the following website: http://www.railserve.com/Equipment/Maintenance/

Another use for the rail lines is storage. Rail car leasing companies stage their railcars about the country when not in use. With access to two rail lines, the Midwest Transload site is well situated for such storage. Another possibility is storing railcars with onboard inventories.

G. Biodegradable Plastic

Biodegradable plastics are being manufactured from corn starch by several companies worldwide. The resins perform like plastic and are being used for products produced through extrusion, injection molding, and thermoforming as well as for films used in food wrap and additives for tires that improve performance. The Midwest Transload site has access to corn and distribution methods, so could serve as a manufacturing location for both the biodegradable plastic and products produced from the plastic.

Task 2: Feasibility Analysis of a Material Recycling Facility

The owner of Perry Ridge Landfill, GERE, agreed to build and operate a materials recovery facility/transfer station as part of its contract to provide waste services to Perry County. A materials recovery facility (MRF) would support the county's achievement of the 25% recycling rate goal set by the state. In addition it will create new jobs and provide feedstock for businesses in the eco-industrial park. Trucks headed for the Perry Ridge Landfill can stop at the MRF on the Midwest Transload site to drop their load. The materials not removed for recycling would be consolidated in transfer trucks to reduce traffic at the landfill. Charging lower tipping fees for the recyclable portion of the load will reduce the overall cost of dumping at the Perry Ridge Landfill. This in turn will increase the attractiveness of Perry Ridge to haulers.

Processed recyclables will either be sold as commodities or sold to co-located businesses on the Midwest Transload site that will use them as raw materials in their manufacturing process.

A. Background

A Material Recycling Facility or Material Recovery Facility is defined by the North American Industry Classification System as primarily engaged in (1) operating facilities for separating and sorting recyclable materials from non-hazardous waste streams (i.e. garbage) and/or (2) operating facilities where commingled recyclable materials, such as paper, plastics, used beverage cans, and metals, are sorted into distinct categories. For this study, the facility considered is one that will separate and sort recyclable materials from non-hazardous waste streams, in this case municipal solid waste (MSW).

The Illinois Recycling Economic Information Study says that recycling manufacturing establishments are critical to Illinois' economy. The demand for recycled commodities in the state isn't being met, so they're imported from other parts of the country and the world.[23] More recycling facilities such as the Material Recycling Facility (MRF) under study can address the need, along with more collection efforts. To support the growth of

[23] R.W. Beck Inc. pES-14

the recycling manufacturing sector, the state has established a comprehensive grant program that helps communities, businesses, and not-for-profit organizations collect and process materials for recycling; helps manufacturers use recycled commodities as feedstock, become more efficient, and reduce waste; encourages innovative technologies and practices that produce marketable products from municipal solid waste; and encourage private investment to manufacture, market, and demonstrate products containing recycled commodities.

In 2003, Perry County generated 16,430 tons of MSW and recycled 1,847 tons for a rate of 11.3%. The goal for recycling set by the state is 25% by the end of the fifth year of their 20-year waste management plan. The MRF promised by GERE, owner of the Perry Ridge Landfill would allow the county to realize that goal as well as create new jobs in the county.

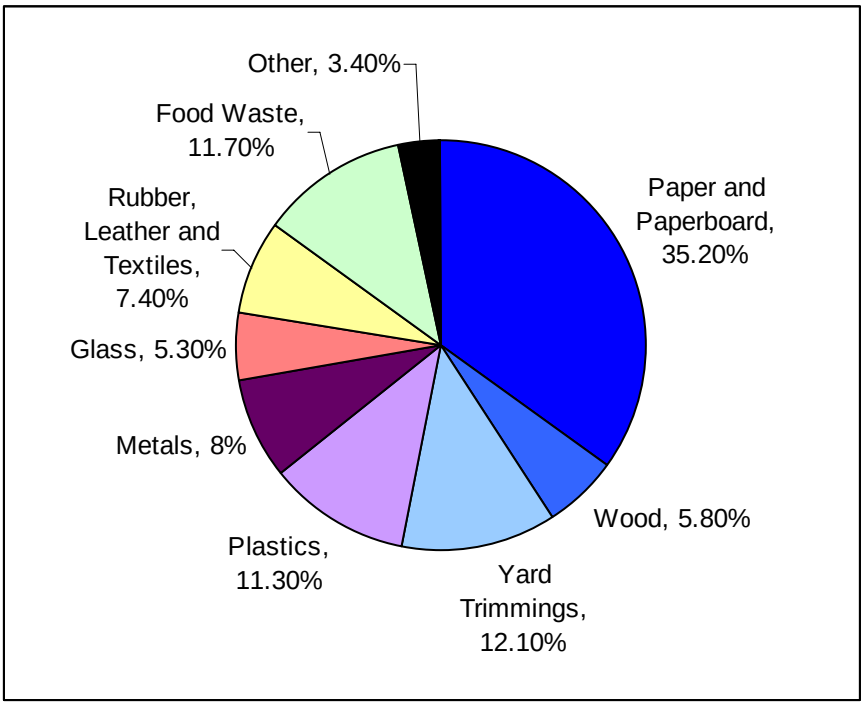
X. Potential Waste Stream(s) Via Rail

Waste streams that could flow to the Perry Ridge Landfill via rail are municipal solid waste or construction waste and demolition debris (C&D debris). MSW is the most dependable waste stream because cities and counties execute multi-year contracts with waste haulers for its disposal. Statewide, 11 percent of waste received by landfills comes from out-of-state. In Illinois EPA Administrative Region Seven, which includes Perry County, 23.9 percent comes from out-of-state. In neighboring Region Six (Metropolitan East St. Louis), out-of-state waste accounts for 49.1 percent of the total. The states exporting waste to Region Six include Arkansas, Georgia, Iowa, Kansas, Kentucky, and Missouri.

A. Municipal Solid Waste

The average make-up of MSW by weight in the United States according to the U.S. Environmental Protection Agency is shown in Figure 5 on the following page.

Figure 5: 2003 U.S. Composition of Municipal Solid Waste by Weight



Source: U.S. Environmental Protection Agency

Ernest H. Dennison from Cottonwood Hills landfill was interviewed about the waste received at their site in St. Clair County in Illinois EPA Region 6. He reported that none of the recyclables have been removed from the waste dumped at their landfill and that it is all trucked in, 75% from out-of-state. Assuming all recyclables remain in waste hauled to Perry Ridge as well, a model of daily and annual potentially recyclable waste streams are shown in Table XX for the current daily rate of 200 tons per day up to the maximum capacity of 1,900 tons per day. Yard trimming are not included in this table because they are banned from landfills in Illinois.

Table 5: Potential Recyclable Content in Waste Hauled to Perry Ridge Landfill

	Daily Waste Stream in Tons				Annual Waste Stream in Tons (calculated using 200 days/ year)			
Paper and Paperboard	80	400	599	759	15,982	79,909	119,864	151,827
Wood	13	66	99	125	2,633	13,167	19,750	25,017
Plastics	26	128	192	244	5,131	25,653	38,479	48,740
Metals	18	91	136	173	3,632	18,161	27,242	34,506
Glass	12	60	90	114	2,406	12,032	18,048	22,860
Rubber, Leather, and Textiles	17	84	126	160	3,360	16,799	25,199	31,918
Food Waste	27	133	199	252	5,312	26,561	39,841	50,465
Other	8	39	58	73	1,544	7,719	11,578	14,665
TOTAL	200	1000	1500	1900	40,000	200,000	300,000	380,000

Source: Calculated by authors based on 2003 U.S. Composition of Municipal Solid Waste by Weight

B. Construction Waste and Demolition Debris

In 1997, the Illinois Department of Commerce and Economic Opportunity, commissioned the Illinois Construction and Demolition Site Recycling Guidebook. In the five county Chicagoland area, C&D debris makes up 20-35% of all solid waste generated.[24] The purpose of the guidebook is to help construction and demolition contractors in Illinois develop and implement efficient programs to reduce the amount of waste generated and landfilled.[25] The guidebook reports that concrete and asphalt are most often recycled into aggregate locally because of their many uses such as road base (concrete) or parking lot construction (asphalt). Metal recycling is also common from both demolition and construction projects. Two waste streams with a less well-developed recycling infrastructure are demolition wood and drywall gypsum. Three causes are listed for the lack of recycling markets: inexpensive waste disposal (low landfill tipping fees), fluctuating commodity prices have undermined the development of a stable market, and the C&D debris processing facilities are heavily regulated increasing operating costs above most other types of recycling facilities. Therefore, the most likely types of C&D

[24] Illinois Construction and Demolition Site Recycling Guidebook, 1997. p.1, _Prepared for the Illinois Department of Commerce and Economic Development.
[25] Ibid.

debris that would be brought in by rail from the Chicago region are demolition wood and gypsum.

Rail generally works best moving large quantities, 200 tons per day or more, long distances, 200 or more miles, with heavy products, 1,300 lbs per cubic yard or more on long-term projects without seasonal variation.[26] The two areas within Illinois that were nearing landfill capacity as of the Seventeenth Annual Landfill Capacity Report – 2003 (Reporting Period: Jan. 1 to Dec. 31, 2003) are the East Central Illinois area and Chicago Metropolitan Area with four and five years of capacity remaining respectively.

XI. Uses of Recyclables

A typical MRF receiving mixed municipal solid waste will sort materials for which markets currently exist and those for which they do not. Typical marketable recyclables are paper, glass, metals, and plastics. Recycled paper can be used to make products we use everyday like manila file folders and cardboard boxes. Color separated green, brown, and clear bottles and jars can be entirely reused in making new glass containers. Metals separated by type such as aluminum and ferrous can be used for new aluminum cans, and rebar respectively. Aluminum is cheaper to recycle than it is to mine making it the most valuable recyclable commodity. Plastics are sorted by their chemical composition and broken down into flakes or pellets. At that point, the plastic flakes or pellets can be turned into new plastic bottles or used for larger structures such as playground equipment.

A. Paper

Paper has many uses as a recyclable material. It can be combusted for use as an energy source or processed for re-use in paper products from newsprint to corrugated cardboard to molded pulp used as an internal packaging container cushioning the shipment of products such as cell phones and computer components. It can also be used as a feedstock for the production of ethanol.

[26] Is Waste Working On The Railroads?, March 1, 1995 12pm, Lynn Merrill, WasteAge.

Paper products can be incinerated at an on-site cogeneration facility that burns MSW and creates electricity that will provide power for the businesses at the Midwest Transload site. The electricity that is not used for the local businesses can be sold to the power grid. The MRF will remove particles that cannot be burned or would become toxic if they were to be burned. The process of incinerating the MSW would be designed as an environmentally sound process. The fly ash waste product that is emitted from the burning waste would be captured and used in the production of cement.

Approximately 40 percent of MSW is comprised of paper and wood. These materials can be used as a feedstock for an ethanol plant. Several companies are working on technologies for the conversion of cellulosic feedstock into ethanol. The starch in the feedstock is broken down into its constituent sugars which are then fermented. The Department of Energy is supporting the development of several aspects of this process to lessen our reliance on imported oil.

B. Glass

Glass must be separated by color to have the most value. Once separated, it is crushed into glass cullet for easy transport to market. Each color can be re-used to make new containers or the glass cullet can be used to make new products such as ceramic tile.

Some glass products cannot be reused. Windowpanes, light bulbs, and television/computer monitors (which contain lead) cannot me mixed with the colored glass for recycling because they contain other materials in them besides pure glass. These other glass materials must be sent to the landfill or sent to a facility that can separate the glass from the other contaminants contained in them.

During the process of sorting glass in the MRF, some glass becomes mixed, broken, or contaminated and cannot be used to create new glass containers. Recyclers have developed new markets for glass that is mixed or contaminated. This glass can be used as a construction aggregate or a sandblasting medium. This glass aggregate represents a good business opportunity, as the glass aggregate can be sold to construction companies. Recycled glass aggregate has been used in construction projects in place of virgin rock

for pipe bedding and trench backfill. Washington State's Department of Natural Resources and Parks found another use for glass aggregate; they used aggregate glass sand in place of filter sand in pool filters in public pools. Glass aggregate is refined into different grades and demands higher prices at finer grades. Sand-grade glass aggregate can also be produced at a lower cost that building sand used for construction sites.

C. Metal

Metals comprise approximately nine percent of MSW in the United States. Most of this metal comes from soda can aluminum, and tin and steel from tuna and soup cans. These metals can be sorted in the MRF using magnets. Aluminum cans can be separated out and sold to off-site plants able to melt down the aluminum cans, separate the contaminants, and produce pure aluminum, which can be turned into aluminum siding, pipes, and cans.

Steel is the most recycled material in America. Annually, steel is recycled more than glass, paper, plastic, and other metals combined. Steel cans can be shredded and cleaned, and can then be sold to paint manufactures, chemical companies, and steel mills, which can remanufacture the steel into steel products.

D. Plastic

There are several types of plastic used in products today. Containers are stamped on the bottom with a number from 1 to 7 indicating their primary resin content. 1 = PET (polyethelene terephthalate) and 2 = HDPE (high-density polyethylene) have the strongest market demand for recycling. As virgin resins they are used in plastic drink bottles and rigid containers. Over fifty percent of recycled PET is used for fiber; one application is the Patagonia Synchilla garments. Recycled HDPE is used in bottles, plastic sewer pipe, and lawn and garden products.

E. Scrap Wood

There are typically three primary sources of scrap wood. These sources are: construction and demolition projects, manufacturing companies that receive or use shipping pallets or crates, and industries that produce wood products. Scrap wood has traditionally been used to create products like particle board. Scrap wood can also be burned to create heat

energy for small/light manufacturing. Charcoal briquettes contain bits of wood char and sawdust. Research is being conducted to determine the potential for using scrap wood as a fuel source by combining it with coal. By infusing coal with wood, the modified coal would burn cleaner and still maintain the right amount of heat.

XII. Job Creation with a Low Technology Material Recycling Facility

As the waste stream grows for this facility so will the job types. Initially, a low-technology material recycling or recovery facility is recommended which will maximize the job creation potential and minimize the capital costs for sorting equipment before local markets are generated to re-use the captured materials.

The material recycling or recovery facility (MRF) must be designed to handle wet/dry municipal solid waste, which is currently being brought to the landfill. Wet/dry municipal solid waste refers to mixed waste that includes wet materials such as food scraps. Under this scenario, sorting of the municipal waste stream is by hand. Some materials are removed by hand on the tipping floor while others are sorted as the waste flows past on a conveyor. Workers target certain recyclables from the mixed waste stream as it travels up the conveyor. After sorting, the density of materials to be recycled is increased with compactors, balers, densifiers, or glass crushers prior to processing on site or at a processing plant. As the volume of waste expands, front loaders are added to assist in the separation of materials on the tipping floor.

Jobs types at a material recycling facility are:

- Manager and Supervisor
- Sorters
    - Glass sorter = 500-800 lbs/hour
    - Plastic sorter = 300-500 lbs/hour
    - Corrugated and other paper sorter = 800-1,500 lbs/hour
- Processing machine operators (baling, shredding, etc.)
- Scale operator

The throughput and recyclables targeted will determine the design of the MRF and the number of employees required. Though the low technology MRF is the most practical for current development, flexibility should be considered in design to allow for more automation and transition into a medium-to-high technology facility. A medium-to-high technology facility is preferable to sort construction and demolition debris. The high tech facility would also be able to handle large loads of waste, which will hopefully come as the waste transport system becomes more efficient with time. The high technology MRF utilizes automated debaggers, finger screens, trammel screens, disc screens, air classifiers, magnetic separators, eddy current separators, pneumatic conveyors, balers, hammer mills, and tub grinders to separate, process, and densify the recyclable materials. These processes involve less labor per ton and more reliance on the mechanized systems.

XIII. Feasibility of Material Recycling Facility

The owner of Perry Ridge Landfill, GERE, agreed to build and operate a materials recovery facility/transfer station as part of its contract to provide waste services to Perry County. Therefore, this study has focused on the sustainability of the MRF. The following variables affect the design of an efficient, sustainable facility:

- Capital cost
- Collection cost
- Operation and maintenance cost (processing)
- Shipping cost of the processed material
- Material storage space
- Public and employee safety
- Public education
- Product quality

A. Capital Costs

Capital costs are determined by the equipment needed. Construction costs for a 500-ton per day facility range from a low end of $5 – 15 million for a low-technology MRF to a high end of $30 – 60 million for a high-technology MRF. Initially, a low-technology MRF is recommended to maximize the job creation potential and minimize the capital

costs for sorting equipment before local markets are generated to re-use the captured materials.

B. Location of the Material Recycling Facility

According to the Decision Maker's Guide to Solid Waste Management produced for the Environmental Protection Agency, the most desirable location for a MRF would be a large uncontaminated plot of land located near industrial uses. There the MRF can take advantage of access to transportation infrastructure associated with industrial uses and remain close to the source of the waste stream. In addition, the report recommends buffers of trees and shrubs to prevent any visual and aural interruption to neighboring uses.[27]

For Perry County, we evaluated two sites, the 500-acre business site and the Perry Ridge Landfill. The Midwest Transload site was chosen because of the rail access to markets for recyclables and waste by rail. In addition, this site will reduce the number of truck trips by consolidating the non-recyclable waste and eliminating the trucking of recyclables back to the Midwest Transload site. Landscaping as a buffer between the MRF and the road and park will screen the building and trucks from view.

C. Collection Costs

Because recyclables will be separated at the MRF, there is no change in the cost of collection. Because some trucks may need to travel farther to the Midwest Transload site than the Perry Ridge Landfill, there may be a slight increase in their travel time and gasoline expense. This cost can be offset by a reduction in tipping fees for the recyclable content in their garbage. For those haulers who do not have to travel as far, they will save money both ways.

Trucks headed for the Perry Ridge Landfill will stop at the MRF on the Midwest Transload site to drop their load. The materials not removed for recycling will be consolidated in transfer trucks to reduce traffic at the landfill. Charging lower tipping

[27] O'Leary, Philip R. and Walsh, Patrick W. Decision Maker's Guide to Solid Waste Management., Volume II (EPA 530-R-95-023) p6-34 – 6-35.

fees for the recyclable portion of the load will reduce the overall cost of dumping at Perry Ridge Landfill. This in turn will increase the attractiveness of Perry Ridge to haulers. The recyclable waste tipping fees should be set at a rate that offsets the cost of the transfer trucks and funds the expansion of the MRF as the waste flow increases, including the acquisition of high-technology equipment.

D. Operating and Maintenance Costs

The pro forma annual cost for equipment operations is 5% of equipment capital costs and for maintenance it's 1% of the structure and site costs.

E. Sustainability

To increase the sustainability of the MRF, we recommend that the County work with GERE to design the facility taking into consideration the potential for expansion and the jobs to be provided. We also recommend that the County work with Midwest Transload to site the MRF adjacent to the rail line and to explore the possibility of a long-term ground lease or sale at a rate consistent with their purchase price of the land from the County. Finally, we recommend that the County explore low cost financing to support GERE's development of the MRF.

XIV. Bulk Commodities for Transloading

Transloading refers to the consolidation and distribution of outbound and inbound commodities. The Midwest Transload site contains the typical rail tracks for spotting rail cars for loading and unloading as well as loading facilities for coal. Additional facilities that would expand the operations of the site are laydown areas for storage of commodities, covered storage areas, warehousing for maximum weather protection, cranes, forklifts, undertrack unloading equipment, truck and rail car scales, and rail moving equipment to expedite placement of rail cars for loading and unloading.

The purpose of the facilities is to provide access to rail shipping to customers who do not have access to a rail siding or the storage capacity to handle the larger rail cars. The addition of warehouse space allows shippers or receivers to consolidate material at a single point for distribution as their business requirements dictate. This can allow a local business to purchase a rail car load of product at lower cost. It also allows several

customers to share a car for delivery of materials from suppliers in a common location like Chicago.

Research indicates that the following bulk outbound commodities could be transloaded on site:

- Coal from local mines
- Corn, soybeans, and wheat from local farmers
- Fly ash from nearby coal-fired power plant
- Processed recyclables

Research indicates that the following bulk inbound commodities could be transloaded on site:

- Plastic resins
- Municipal solid waste
- Construction and demolition debris

Additional infrastructure would be required to transload many of the commodities. Markets for the materials will determine whether the investment in that infrastructure is warranted.

XV. Bulk Commodities as Feedstocks for Manufacturers on Midwest Transload Site

The bulk commodities that have use as feedstock for manufacturers locating on the Midwest Transload site are corn, recyclables from municipal solid waste, and fly ash. Corn has use as an input into the manufacture of ethanol as well as a biodegradable resin. The recyclables from municipal solid waste can be processed for use on site to manufacture new products such as glass tiles. Fly ash can be used to manufacture pavers, bricks, or other concrete building materials.

XVI. Job Creation from Utilization and Re-Utilization of Bulk Commodities

Utilizing rail to transload waste and other commodities from various areas will create jobs such as freight car repair technicians, forklift operators, mechanics, track

maintenance technicians and materials handlers. These occupations offer average hourly wages of from $13.00-$29.00. Also related to the transportation of commodities, jobs in the trucking industry will be increased. These types of jobs may include drivers, maintenance and repair technicians and will generate average wages between $11.50 and $16.00 per hour.

While it is understood that the number of staff necessary for the successful operation of a MRF depends on the size, the proposed MRF would begin by generating from five to 15 full-time and part-time jobs per year. These jobs generate wages varying from minimum wage of $6.50 per hour to $15.00 per hour. As the waste flow increases, Perry Ridge Landfill will produce from additional jobs, which will offer wages similar to that of the MRF.

An ethanol plant producing 40 million gallons daily would produce 40 jobs paying between $22.97 and $24.02 per hour.[28]

The manufacture of biodegradable resin; glass tiles; or pavers, bricks, or other concrete building materials will create jobs for industrial production managers (median wage $34.15/hr), industrial engineering technicians (median wage $19.88/hr), machine operators (median wage $13.96/hr), molders and casters (median wage $12.02/hr) helpers - production workers (median wage $8.81/hr), and office staff (median wage $10.00 – $12.00/hr).[29] The average number of employees in a manufacturing firm is 8 so these three businesses would generate roughly 24 jobs.

[28] Tsuyoshi Yamasaki email correspondence with the National Corn Grower Association, 11/18/2004
[29] Wage Data 2005, Department of Employment Security, http://lmi.ides.state.il.us/PDFs/statewidewage_pub.pdf

Task 3 – Eco-Industrial Park Model for the Midwest Transload Site

A. Background

The following section was excerpted from Infrastructure Resource Manual for Eco-Industrial Development produced in July 2002 by the National Center for Eco-Industrial Development which was co-founded by the University of Southern California Center for Economic Development and the Cornell University Work and Environment Initiative.

The concept of the EIP can be quite flexible within the context of local market conditions and environmental constraints. Market conditions include production demands and other location decisions made by key EIP firms. In addition to those identified above, key environmental constraints include air pollution, noise pollution, hazardous waste and the status of available land. Some EIP's may be well suited for redevelopment of brownfields, while others work well adjacent to recreational parks or other open space uses. EIP's often feature the symbiotic recycling or reuse of materials, water or energy, whereby the waste of one firm or municipal facility becomes the feedstock for another firm, or is put toward some other symbiotic purpose. Innovative relationships to exchange materials, water or energy developed among private firms and also with public facilities can lower production costs and reduce environmental impacts. Some common EIP conceptual types include:

- **Co-Located EIP for Industrial Symbiosis**
- **Virtual EIP for Industrial Symbiosis**
- **Resource Recovery Park (Material Recovery Facility Park)**
- **Green Technology Park**
- **Industrial Eco Park**
- **Environmental Management System Park**

The co-located and virtual EIP's are two major categories of EIP's that feature materials, water and/or energy cycling. However, the types are distinct. In a collocated EIP, firms or municipal facilities are located adjacent to one another. Co-location is best suited for exchanges where pipe-to-pipe connections are required. In contrast, facilities in a virtual EIP need not be located adjacent to one another. The virtual EIP facilitates the exchange

of byproduct materials across a region. The "virtual" label captures the notion that computer programs and systems may be designed to identify exchange partners, create electronic links among them, and optimize for efficient transportation of materials.

The ***Resource Recovery Park*** is an EIP built around recycling post-consumer secondary materials. In its broadest sense, a resource recovery park can be seen as the co-location of reuse, recycling, compost processing, manufacturing, and even retail businesses. In parks of this type, a materials recovery facility (MRF) may be paired with a number of firms that manufacture products from materials recovered by the MRF from municipal solid waste streams. The park may share special contracting or financing arrangements and common marketing, whether or not the firms are actually co-located. The ***Green Technology Park*** attempts to capitalize on growing markets for clean technologies. Local governments may choose to identify special incentives for these 2 parks when new regulatory mandates increase local markets for pollution control or energy efficiency technology. A goal is to develop local jobs that meet important environmental goals.[30] Again, member firms may co-locate depending upon benefits ranging from common suppliers to common customers, and special marketing arrangements.

The ***Industrial Eco Park*** and the ***Environmental Management System Park*** are both strategies for reducing the impact of traditional industrial parks on the environment. The Industrial Eco Park uses new design initiatives identified throughout this manual to minimize its environmental footprint. For example, swales or bioremediation might be used to treat and control effluent water or run-off water within a park.[31] In an Environmental Management System (EMS) Park, park management can require tenant firms to be ISO (International Organization for Standardization) 14001 certified. The Park itself can be ISO certified or operate under a site-wide EMS, enabling firms to work together to implement a common environmental management system to more effectively

[30] LA Business Team. "Environmental technology industry survey." (http://www.freeonlinesurveys.com/rendersurvey.asp?id=11823)
[31] Living Machines, Inc. "Ethel M Chocolates Case Study." Accessed June 21, 2002 (http://www.livingmachines.com/htm/study2.htm)

track energy use, water use and pollution, working toward continuous improvement through waste minimization and other strategies.

XVII. Business Uses for Recycled Materials Generated by the Material Recovery Facility

The Resource Recovery Park model provides a basis for attracting businesses to the Midwest Transload site to co-locate with the proposed Material Recovery Facility. The types of businesses would include companies that reuse, recycle or process post-consumer materials, or that manufacture items from the processed recyclables. As was shown in Chapter X on Business Opportunities, potential tenants are a composting operation, a glass tile manufacturer, and an ethanol manufacturer. Another potential tenant is a concrete building material manufacturer. Depending on the type of product materials used include fly ash, construction and demolition debris (C&D) crushed concrete, or mixed glass cullet. The materials used from the waste stream for the potential tenants are shown in the following table along with outputs generated that can be used by another business.

Table 6: Material Flows at Material Recovery Facility-based Eco-Industrial Park

Business	Input	Received From	Output	Potential Users
Material Recovery Facility	Municipal Solid Waste Stream	City/County Solid Waste Pick-up	Organic Waste, Glass Cullet, Green Waste, Paper, and Wood	Tenants shown in table
Composting Operation	Organic Waste	MRF	Compost	Local Farmers and Households
Glass Tile Manufacturer	Glass Cullet (Mixed Glass)	MRF	Filtered Waste Water	Treated for landscaping use
Concrete Building Material Manufacturer	Fly Ash, Crushed Concrete, Glass Cullet	Power Plant, C&D, MRF	Waste water	Treated for landscaping use
Corn-Based Ethanol Plant	Corn	Local Farmers	Distillers Grain	Animal Feed
			CO_2	See Below

A. Uses for Carbon Dioxide

Common uses for carbon dioxide include fire extinguishing systems; carbonation of soft drinks; freezing of food products such as poultry, meats, vegetables and fruit; chilling of meats prior to grinding; refrigeration and maintenance of ideal atmospheric conditions during transportation of food products to market; enhancement of oil recovery from oil wells; raw material for production of various chemicals and treatment of alkaline water. Greenhouses have shown that by using carbon dioxide production yields can increase by 20%. A typical carbon dioxide level would be about 1,000 PPM (parts per million).[32]

XVIII. Mix of Businesses in Resource Recovery Industries in Perry County

We found no companies in resource recovery industries in Perry County except for local recycling efforts. The local recycling operations could save transportation costs by delivering their collected materials to businesses processing them at the Midwest Transload site or by cooperatively selling and transporting them with the materials generated at the MRF.

XIX. Potential Material Exchanges

In addition to the Resource Recovery business material exchanges in Table 5 in Chapter XVII, additional types of businesses with potential material exchanges were identified for location at the Midwest Transload site or nearby.

A. Living Machine™ Waste Water Treatment Plant

The site has very little infrastructure today so developing infrastructure that is compatible both with the adjacent state park and the targeted businesses is essential. One requirement is for waste water treatment. The Living Machine™ is a waste water treatment system that can treat water from residential, commercial, or industrial uses producing clean water and biosolids.

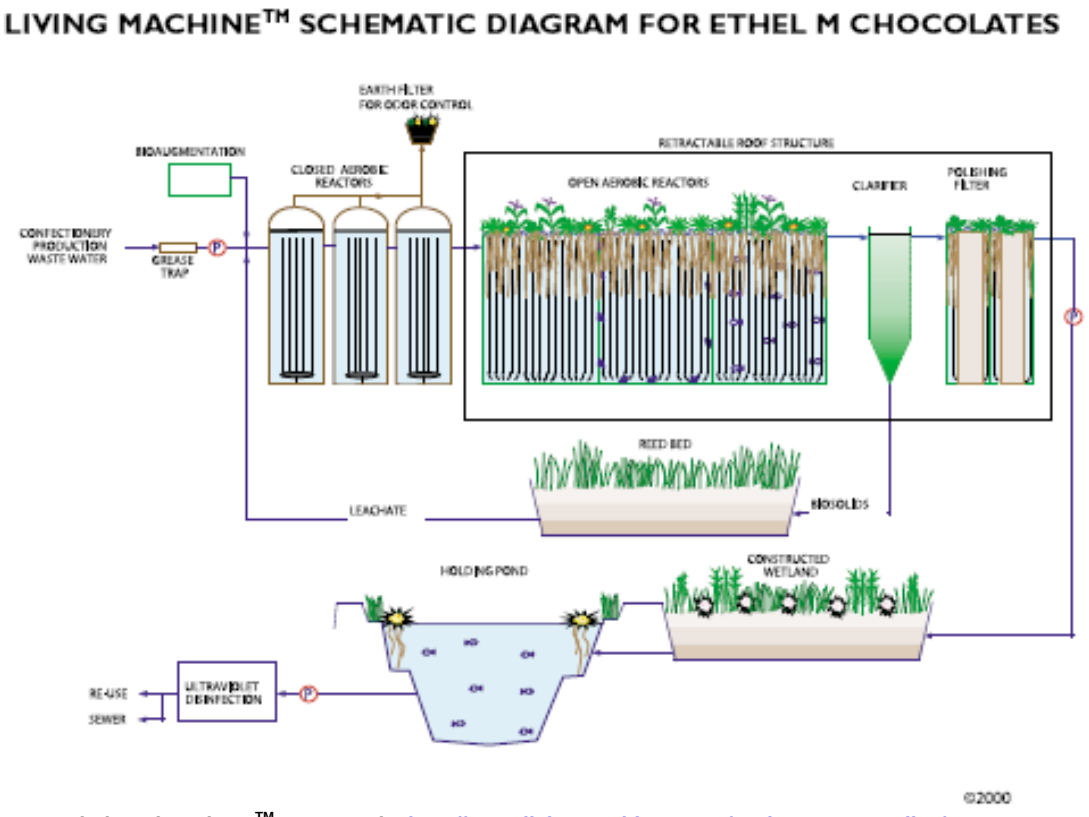
Over 30 years ago, Dr. John Todd began researching how to utilize the processes of ecosystems to develop industrial processes that would be sustainable. The result was the

[32] Carbon Dioxide (CO_2) Applications and Uses, http://www.uigi.com/carbondioxide.html

Living Machine™. Waste water flows through a series of tanks containing different groups of bacteria, algae, snails, plants, fish and other organisms that decompose, eat, and grow on the material in the water until the water is pure enough to be recycled. The treated water is often used for non-potable uses such as flushing toilets, landscape irrigation, or coolant towers.

There are several examples of existing Living Machine™ waste water treatment systems in the United States: the Ethel M Chocolates factory processes 32,000 gallons per day of industrial waste water and the Narragansett Bay, Rhode Island municipal waste water treatment facility processes 16,000 gallons per day. The diagram in Figure 6 shows the process by which waste water is purified in the Living Machine™ at the Ethel M Chocolates factory in Nevada.

Figure 6: Living Machine™



Source: Ethel M Chocolates™ Case Study, http://www.livingmachines.com/project-case-studies/

In addition to contained waste water treatment, ponds and lakes can be cleaned and their ecologies restored through this technology, with floating islands called Restorers. The basic physical components to Restorers are similar to the Living Machine™ except for being free floating and living in one system. The components are:

1. The floating structure to support media, air distribution systems and dense arrays of higher plants, including shrubs and trees.
2. The high surface area media for attached-growth (biofilm) treatment and support of diverse biological communities.
3. The air distribution system for aeration and circulation.
4. The energy system to provide electrical power to blowers and compressors that distribute the air.
5. The biology and ecology of the Restorer, including native wetland plants, fish, bacteria, fungi, algae, protozoa and a wide array of life forms from many different phylogenetic kingdoms.[33]

Use of Restorers could improve the ecology of the lakes and ponds in Pyramid State Park, enhancing the fishing, camping, and nature experiences of visitors. A Living Machine™ at the Midwest Transload site coupled with Restorers in the state park could include a visitor center on the Midwest Transload site to educate local school children and visitors about natural ecosystems.

B. Aquaponics

Aquaponics is the symbiotic combination of aquaculture or fish farming with hydroponics, the cultivation of plants in water. The symbiotic nature comes from the nutrients introduced as fish waste which the plants remove as they use it for food. The plants serve as a biological filter for the fish reducing the aquaculturist's reliance on more expensive mechanical and biological filtration. In turn, the hydroponics grower's reliance on buying and mixing fertilizer is reduced. In addition, the amount of water needed for either operation is reduced as the water can be reused.

[33]Ocean Arks International – Natural Treatment Systems: Restorer Technology, http://www.oceanarks.org/restorer/

Aquaponics uses greenhouses to provide a higher yield to offset the cost of production through a controlled climate and faster growth. To be successful, the fish and plant must be combined properly to create a mini-ecosystem; in addition, there must be a market for both the fish and the plants. In the U.S. today, the fish and plants grown through hydroponics must command high market values to cover the cost of operations. In an eco-industrial park setting some additional costs can be lowered such as the cost of disposal of the fish waste not used by the plants, and water through use of recycled water available from a Living Machine™ waste water treatment plant.

C. Other Potential Exchanges

In Chapter VIII, Business Opportunities, a Railcar Repair Facility or Railcar Storage, and biodegradable plastic were suggested for the site. In Table 5 on the next page, those businesses are shown along with the Living Machine™, aquaponics, ethanol (both corn-based and cellulosic), and corn-based plastics.

Although the material exchange is limited for the railcar businesses, these businesses offer additional opportunities to the exchange network through the eventual transportation of waste and the export of processed recyclables or finished goods. In addition, the biodegradable plastic provides a new market for the local corn and will provide a product to ship out via rail and with the addition of manufacturing capability, the development of products made from the biodegradable resin.

Table 7: Potential Material Exchanges

Business	Local Input	Received From	Output	Potential Users
Living Machine™ Waste Water Treatment Plant	Waste Water	Tenants, Perry Ridge Landfill	Purified Water	Landscaping, Tenants
			Biosolids	Composting
Aquaponics	Purified Water	Living Machine™	Waste Water	Living Machine™
	Distillers Grain (feed)	Corn-based Ethanol Plant	Plant and Fish waste	Composting
Corn-Based Ethanol Plant	Corn	Local Farmers	Distillers Grain	Aquaponics – Fish Feed
			CO_2	Aquaponics – Greenhouses
Cellulosic-Based Ethanol Plant	Corn	Local Farmers	Gypsum	Composting
			Lignin	Fuel for Energy Plant
			CO_2	Aquaponics – Greenhouses
Biodegradable Plastic	Corn Starch	Local Farmers	Waste water	Living Machine™
Railcar Repair	Railcars	Railcar owners	Mixed waste	MRF or Perry Ridge Landfill
Railcar Storage	Railcars	Railcar owners, local businesses	Minimal mixed waste	MRF or Perry Ridge Landfill

XX. Eco-Industrial Park Model

The recommended Eco-Industrial Park Model is a virtual network anchored by an Environmental Business Park located on the Midwest Transload site. To introduce the type of industrial park is a case study of the Devens Enterprise Commission Environmental Business Park and the Green Business program in Northern California.

A. Environmental Business Park at Devens

The Environmental Business Park at Devens began with the decommissioning of the Army base at Fort Devens. A community outreach process was conducted by the Fort Devens Redevelopment Board with over 90% of the respondents indicating that environmental protection and conservation were high priorities. Out of the community feedback, a charrette was conducted to develop a sustainable reuse plan. High standards were required for the siting of new development throughout the base to ensure sensitive

treatment of vegetation, water resources, topography and adjacent uses. These high standards help to insure the sustainability of the reuse. Infrastructure was required to be developed in an "environmentally sound" manner, balancing economic development interests with environmental protection. The waste water treatment facility was to be used as a source of research and development "consistent with sustainability goals." By-Laws were developed to build upon the sustainability goals and objectives of the reuse plan covering zoning, density, dimensional requirements, and natural resource protection.

One of the elements of the resulting plan was an environmental Business zone on the site. A key component of the environmental business zone was to provide material and by-product exchanges between these companies and those elsewhere on the base. The benefits expected from the material and by-product exchanges include the reduction of operating costs (energy, materials and water), reduction of disposal costs, income from sales of by-products, reduction of environmental liability, improved public image, increased protection of natural ecosystem, more efficient use of natural resources, and improved health for employees and community.

B. Green Businesses

In Northern California, the Bay Area Green Business Program was formed to assist, recognize and promote businesses and government agencies that volunteer to operate in a more environmentally responsible way. To be certified "green," participants must be in compliance with all regulations and meet program standards for conserving resources, preventing pollution and minimizing waste. Since its inception in 1996, over 500 businesses and public agencies have been certified by the coalition of environmental agencies and utilities that created the program.

C. Proposed Pyramid Environmental Business Park

In order to attract a mix of businesses offering long-term quality employment, an environmental eco-industrial business park is proposed for the Midwest Transload site that we are calling the Pyramid Environmental Business Park. Some of the businesses will require additional infrastructure such as power, water, or waste water treatment to

locate on the site; for this discussion those needs are assumed to be met providing additional incentives to prospective tenants.

Tenants that may be attracted more easily include the railcar repair and storage businesses, the corn-based ethanol plant, concrete building material manufacturer, and corn starch biodegradable resin manufacturer because one of their prime inputs is already located in the region. With the addition of the Materials Recovery Facility, the glass tile manufacturer, composting operation, and other recycled material manufacturers will be interested in locating on site to be near one of their prime inputs. The Living Machine™ waste water treatment plant should be planned into the growth of the park and the need for waste water treatment. With its addition to the site, the site becomes attractive to a aquaculture (fish farm) or aquaponics (fish and hydroponic plant farm) operation.

Table 8 on the following page summarized the material and water exchanges between proposed tenants of the eco-industrial business park.

Table 8: Pyramid Environmental Business Park

Business	Local Input	Received From	Output	Potential Users
Material Recovery Facility	Municipal Solid Waste Stream	City/County Solid Waste Pick-up	Organic Waste, Glass Cullet, Green Waste, Paper, and Wood	Tenants shown in table
Concrete Building Material Manufacturer	Fly Ash, Crushed Concrete, Glass Cullet	Power Plant, C&D, MRF	Waste water	Living Machine™
			Waste	Perry Ridge Landfill
Glass Tile Manufacturer	Glass Cullet (Mixed Glass)	MRF	Filtered Waste Water	Fish Farm
Living Machine™ Waste Water Treatment Plant	Waste Water	Tenants, Perry Ridge Landfill	Purified Water	Landscaping, Tenants
Fish Farm or Aquaponics	Purified Water	Living Machine™	Waste Water	Living Machine™
	Organic Waste, Distillers Grain	MRF	Fish and Plant Waste	Composting Operation
Composting Operation	Organic Waste	MRF	Compost	Local Farmers and Households
Corn Starch Biodegradable Resin	Corn Starch	Local Farmers	Waste water	Living Machine™
Corn-Based Ethanol Plant	Corn	Local Farmers	Distillers Grain	Aquaculture
			CO_2	Aquaponic Greenhouses
Biodegradable Plastic	Corn Starch	Local Farmers	Waste water	Living Machine™
Railcar Repair	Railcars	Railcar owners	Mixed waste	MRF or Perry Ridge Landfill
Railcar Storage	Railcars	Railcar owners, local businesses	Minimal mixed waste	MRF or Perry Ridge Landfill
Other Recycled Material Manufacturer	Sorted, Processed Recyclable	MRF, waste processer	Waste water	Living Machine™

XXI. Resources

A. Fly Ash

The Fly Ash Resource Center
The Fly Ash Resource Center provides information on coal combustion byproducts (CCBs): Materials Research, Environmental, Standards/Quality Assurance, Marketplace.
http://www.geocities.com/CapeCanaveral/Launchpad/2095/flyash.html

American Coal Ash Association
15200 East Girard Avenue Suite 3050
Aurora, CO 80014
Telephone: (720) 870-7897
E-Mail: info@acaa-usa.org
Website: http://www.acaa-usa.org/

Combustion Byproducts Recycling Consortium
West Virginia University
National Research Center for Coal and Energy
PO Box 6064
Morgantown, WV 26506
Telephone: (304) 293-2867
Fax: (304) 293-7822
Website: http://ecbc.nrcce.wvu.edu/programs/cbrc/

B. Ethanol

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Ethanol Plant Development Handbook: Fourth Edition

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http://www.plasticsresource.com/s_plasticsresource/

E. Biodegradable Products (Plastics from Corn Starch)

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Manufactures Ecoflex a biodegradable resin. A BASF product.

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Investor information: investor.relations@cereplast.com

Website: http://www.cereplast.com/index.html

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Fax: (203) 431-0451
E-mail: gioffre@materbi.com
Web site: www.materbi.com

F. Living Machine™

Living Designs Group, LLC is a consulting and design group specializing in the holistic integration of water, energy and green building systems. They are a group of architects, engineers and ecologists that specialize in incorporation of workable sustainable concepts into design projects.

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Ocean Arks International, founded in 1981 by visionary Ecological Designer Dr. John Todd, is a global leader in the field of ecological water purification. In response to the alarming rate of natural resource exploitation and depletion, their mission is to disseminate the ideas and practices of ecological sustainability throughout the world.

Ocean Arks International
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Telephone: 508-548-8161
Email: info@oceanarks.org

Project Case Studies: http://www.livingmachines.com/project-case-studies/

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Appendix: Ethanol Plant Project Development Initial Considerations

Excerpted from 2001 Ethanol Plant Development Handbook, 3rd Edition, BBI International, p. 4.

1. Does the local, regional, and national demand for ethanol justify the creation of additional production?
    a. National – YES
    b. Local and regional – YES suggested by plant proposed in Randolph County that failed to get public support
2. Are there markets for ethanol co-products (distillers grain, lignin, CO_2)?
3. Is there political support in the state for the development of such a facility and is the timing right? Are there any state incentives? YES, state is largest producer of ethanol, with current price of gasoline, IEPA is offering incentives to motorists to use E85 which costs $.50 less than gasoline. E85 is fuel made from 85% ethanol and 15% unleaded gasoline. (http://www.illinoisgreenfleets.org/)
4. Are there sufficient utilities available (water, natural gas, electricity) to properly service the plant? With infrastructure investment they are available.
5. Is there rail and truck service? YES
6. What is the historic price and availability of feedstock for the plant and is it transportable? Historic commodity prices $2-$3 per bushel of corn.
7. Can the local wastewater treatment facility handle any increase in effluent as a result of the ethanol plant? Wastewater would have to be trucked unless a plant is built on site.
8. Is there land availability in the proper location relative to the community in which it will be built? YES
9. If it's proposed to be a farmer-owned cooperative, would the mean income of the area farmers support the type of investment required? N/A
10. Is there broad-based community support for the project? YES, but the Illinois Department of Natural Resources would need to be brought on board.
11. Are there well-respected individuals who will step up and lead the project in its early stages and who have the time to devote to seeing it through to fruition? YES
12. Are there sufficient mechanical and electrical services available to support the plant? YES
13. Is there sufficient manpower available in a reasonable proximity to ultimately run the plant? YES