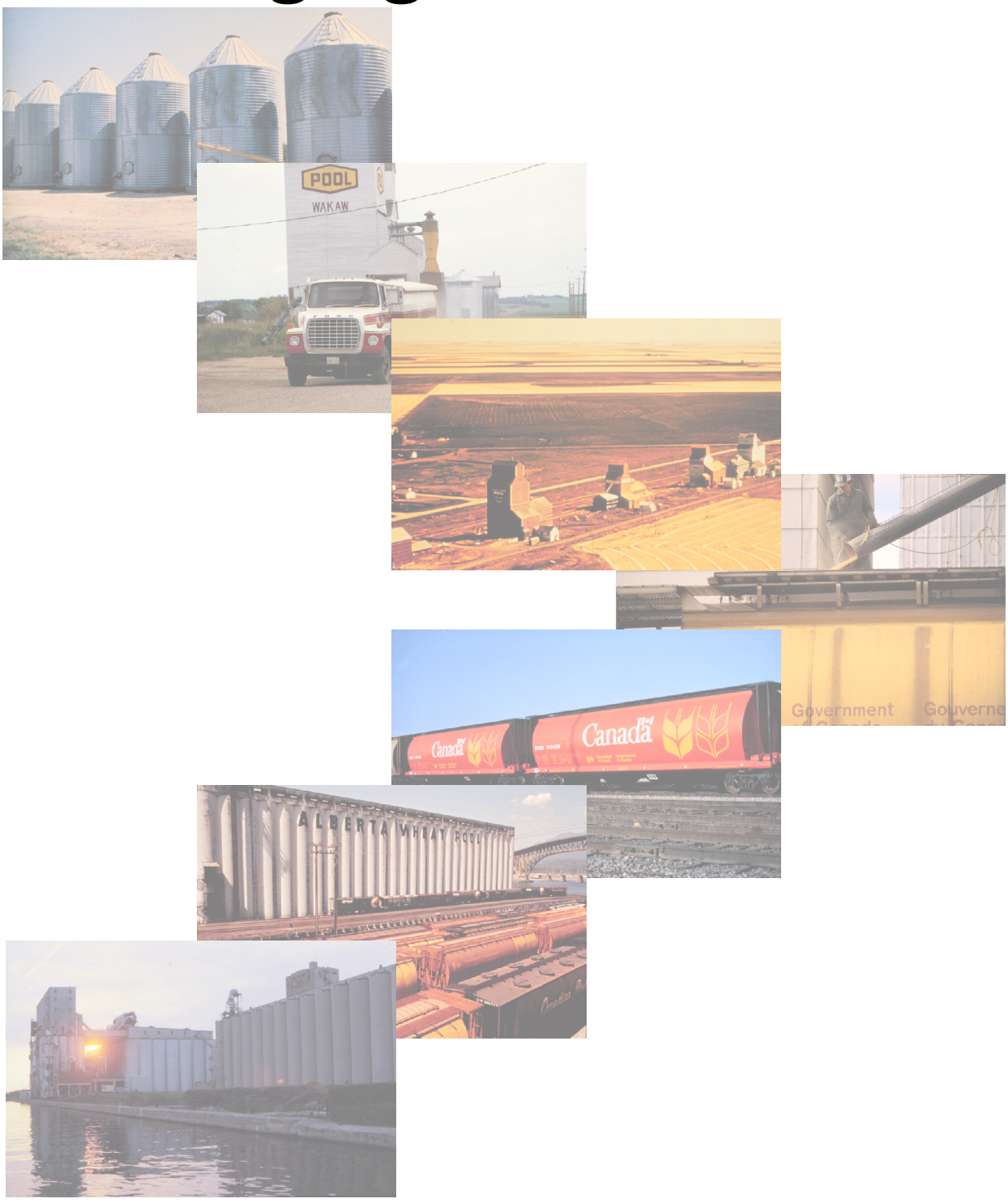
An Overview of Grain Segregation Issues



Agriculture and Agri-Food Canada

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Canada

An Overview of Grain Segregation Issues

Policy Development and Program Services
Policy Branch, AGPD

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"Vue d'ensemble des questions relatives à la ségrégation du grain"

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EXECUTIVE SUMMARY

Two questions concerning grain segregations that were raised in the Phase I report of the Estey transportation review were:

(1) can the returns from many grades and protein segregations offset the cost of maintaining these segregations from farm gate to export position?

and (2) can the grain handling and transportation system accommodate the increase in the number of new specialized products being offered to importers abroad?

While this study addresses some of the elements concerning these two questions, it is not an attempt to give a complete and quantitative analysis. However, it does provide an overview of the effects of increasing segregations on the grain handling and transportation system in western Canada.

The first section of this study provides an insight into the Canadian grain grading system including such concepts as test weight, varietal purity, vitreous kernels and soundness. Other important concepts such as protein content and identity preserved shipments also are discussed.

The background section highlights some of the more prominent issues concerning grain segregation. The number of segregations in store, elevator consolidation and CWB contract calls all play a role in the discussion of how grain segregations affect the grain handling and transportation system.

The benefits section identifies some of the qualitative benefits of grain segregation to the stakeholders in the Canadian grain industry and quantifies some of the benefits of grain segregation to producers. These results were limited to an analysis of CWRS and CWAD wheat. The results show that significant revenue increases in producer returns for CWRS wheat are due to protein segregations. For #1 CWRS, the increase was estimated to be $11.07 per tonne in 1996/97.

The discussion concerning the costs associated with segregations of grain focuses on factors that contribute to additional operating costs. Concepts such as storage capacity, turnover ratios, and logistics are integral to this analysis. The difficulty in providing any kind of quantitative analysis lies in identifying the lower costs that the system would have had if fewer segregations existed. Where possible, cost data from other sources is presented for analysis and discussion.

If customers are willing to pay premiums on the basis of high quality or distinctive characteristics, additional segregations may be beneficial in the Canadian grain handling and transportation system. However, the most desirable and efficient number

of grain quality segregations depends on the benefits and costs associated with additional segregations beyond the base grades.

Three related areas that warrant attention are: identity preservation, CWB contract calls and additional CWB protein segregation.

Given that the study's analysis was limited to CWRS and CWAD segregations, it would be beneficial to conduct further quantitative analysis of the costs and benefits on the other major crops to determine the net impact of additional segregations as well as to determine the optimal number of segregations. Each additional segregation may result in diminishing marginal returns and increasing marginal costs. Increasing (decreasing) the number of segregations impacts all aspects of grain handling, transportation and marketing.

CHAPTER 1 INTRODUCTION

In his Phase I Report on the grain handling and transportation system, Justice Willard Estey identified fifteen issues raised as concerns during his consultations with grain industry stakeholders . One issue was the increasing number of grain segregations and varieties of special crops that are entering the grain handling and transportation system.

From the Phase I Report of the Estey Commission, two questions have emerged pertaining to grain segregations. These questions are:

(1) do the returns from the many grades and protein segregations of wheat offset the cost of maintaining and moving these segregations from farm gate to export vessel?[1]

and (2) can the grain handling and transportation system accommodate the increased number of new specialized products being offered to importers abroad?

The increasing number of grain segregations poses many challenges for the grain transportation and handling system as the classes and grades of grain must be stored and transported separately. The current trend toward rationalization of both the railway and elevator systems may amplify the magnitude of these challenges, as the system, in its present form, may be becoming increasingly less conducive to the storage and movement of small amounts of grain.

The economic benefit from grain segregations accrue from the premiums that customers are willing to pay for parcels of grain with the specific qualities most suited to their needs. Additional segregations on the basis of especially high quality or distinctive characteristics may be beneficial if there is sufficient demand for grain with those characteristics.

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[1]For the purposes of this report the term “grade” is used as it is defined in the Canadian Grain Commission’s “Official Grain Grading Guide”. Segregations are differentiations of grains based on official grade criteria and on non-grade criteria such as protein content, and varietal types. For example, two samples of grain, identified as 1CWRS 13.0% protein and 1CWRS 14.0% protein would constitute one grade and two segregations. Two samples identified as 1CWRS 13.0% protein and 2CWRS 13.0% protein would constitute two grades and two segregations. Because of additional quality characteristics, such as protein content, which are not part of the official grade, the number of segregations will be equal to or greater than the number of grades.

1.1 Objective

This report will provide some insights into the two questions on segregations raised by the industry during the Phase I consultations and suggest issues pertaining to this topic that may require further study.

The overall objective of this study is to provide an overview of the positive and negative effects of increasing the number of segregations within the grain industry in western Canada.

It will provide a description of how the current system of segregations has evolved, an analysis of how grain segregations have affected the operations of the grain handling and transportation system and a general, balanced discussion of the resulting costs and benefits associated with segregations.

1.2 Structure of the Paper

This report has been structured into five sections: background, benefits of grain segregation, costs, related concerns, and conclusion and areas for further study. The *background* section describes the current grain grading system and provides an overview of the source and number of grain segregations in the system. The *benefits of grain segregation* section provides a quantitative analysis of the benefits accruing to producers of Canadian Western Red Spring (CWRS) wheat and Canadian Western Amber Durum (CWAD) wheat due to the addition of segregations (primarily protein levels) in recent years. The *costs of grain segregation* section discusses the additional costs imposed on the system due to the increasing number of segregations. The *related concerns* section examines some new and upcoming issues dealing with segregations that will affect the industry in the short and longer term. The *conclusion and areas for further study* section provides an overview of the paper's findings and areas that require further research. A detailed literature review may be found in Appendix 1. Appendix 2 provides data on the calculations undertaken to quantify the benefits of grain segregations realized by producers.

CHAPTER 2 BACKGROUND

Developments in the world grain markets have caused a substantial increase in the number of grain quality segregations. As a result of both the loss of the former Soviet Union as an export market for grain and China seeking to become more self-sufficient in grain production, Canada has gone from selling large volumes of grain under contracts with flexible grade options to selling smaller volumes of more diverse products with strict requirements.

Buyers are seeking consistent shipments of grain with specific characteristics, such as protein content or gluten strength, that they need for their particular industry. Canada has developed a reputation in the world market as a dependable supplier of high quality, clean grain that is consistent from shipment-to-shipment. This high level of consistency is achieved, in part, by segregating grain into categories that meet buyers' specific demands. It is Canada's grading system, in conjunction with the varietal registration system, that evolved over time to provide this marketing advantage. This trend of increased segregation of grain is projected to continue as customers demand even more specific grain characteristics and as the market for genetically modified crops develops.

2.1 The Canadian Grain Grading System

The Canadian grain grading system has been designed and implemented to satisfy a number of requirements. The five principal reasons for the existence the Canadian grain grading system are:

(1) to provide producers with a price that is relative to the quality of grain they have produced,

(2) to facilitate grain handling,

(3) to simplify trading by relating price to quality,

(4) to enable a customer to obtain the same quality on a consistent basis over time,

and (5) to provide sufficient quality divisions to permit buyers to choose according to their needs.

The Canadian grading system as it exists today is, for the most part, visually based. Grain inspectors, elevator managers and others involved with the operational evaluation of grains visually examine samples of grain for the presence of degrading factors and make primarily subjective assessments to assign a grade to a sample of

grain.

Grades are established under authority of the Canada Grain Act on recommendation by the Canadian Grain Commission (CGC). Grades of grain are defined in written form in the Canada Grain Regulations and the Off-Grades of Grain and Grades of Screenings Order.

The Canadian grading system incorporates the use of two standards both from the standpoint of specifications and physical samples. *Primary standard samples* reflect the minimum acceptable visual quality for each grade of grain as defined in the grade definitions that appear in the Regulations. Primary standard samples are used as a visual grading guide in the grading of grain other than western grain discharged from a terminal, transfer or processing elevator. *Export standards* are prepared for the major grades of grain exported from Canada. They reflect a higher quality than the primary standards and are a reflection of the logistics of a bulk handling system and the quality enhancement that occurs as grain moves through the system.

The Canadian grading system relies on the basic premise that grain which is sound in physical appearance, is sound in terms of end-use quality. Grading factors are visually assessed and applied by grain inspectors to ensure the performance of a particular type of grain in the production of flour, animal feed or other products. Variety registration and quality research systems ensure that only varieties of a certain quality are registered.

The system is both objective and subjective. It is objective to the extent that grades are assigned on the basis of measured tolerances and specifications. Grading becomes more subjective when samples are compared to standards for determining soundness.

2.2 Canadian Grading Factors

The principal factors considered when grading Canadian wheat are: test weight, varietal purity, vitreous kernels, soundness and maximum limits of foreign material. The predominant grading factors in any given year will vary depending upon the growing conditions experienced in that year.

(a) Test Weight

Test weight is, to a certain extent, indicative of potential flour yield. A low test weight within a class of wheat also can indicate poor flour colour and higher levels of ash.

(b) Varietal Purity

Varietal purity does not necessarily mean that a sample must consist of only one variety. Mixtures of varieties are permitted, provided that each variety in the mixture is equal in quality to the varietal standard established. Presently that varietal standard of

quality for the top three grades of Red Spring wheat is the variety “Neepawa”. Varieties not registered under the Seeds Act will qualify only for the lowest grade, in the case of wheat, Canada Feed.

The consistently high level of quality that has been characteristic of Canadian wheats over the years is attributable in large part to varietal standards. An established varietal standard ensures that a class of grain maintains an intrinsically high standard of quality. Consequently, each Canadian variety must be either visually distinguishable from all other classes or visually identical to another previously registered variety to ensure that varieties are not mixed.

(c) Vitreous Kernels

Vitreous kernels are whole or broken, reasonably sound kernels that show clear evidence of vitreousness, i.e. the natural translucent colouring that indicates kernel hardness, even though they may be bleached.

(d) Soundness

Kernels that are well developed, mature and practically free of physical damage are classed as sound kernels. Damaged kernels are usually the result of weather conditions, fungi, disease and insects. In establishing the degree of soundness, judgement is exercised to determine the relative degrees of damage or immaturity in comparison to the current standard sample for the grade.

(e) Maximum Limits of Foreign Material

Material that is readily removable from grain using approved cleaning methods is referred to as “dockage”. Foreign material includes other cereal grains, large weed seeds or other matter remaining in the sample(s) after the removal of dockage. Foreign material is considered a grading factor, while dockage is not.

Legislation in Canada prohibits terminal and transfer elevators from shipping grain containing dockage material or grain which is not considered commercially clean, unless the buyers agree and permission is given by the Canadian Grain Commission.

The fact that the grading system is of a subjective nature periodically results in problems when grain shipments receive different grades at the prairie and port position. These misgradings may reduce the system's ability to meet sales commitments. In response, the CGC and industry are continuing to develop and implement more objective grading techniques. For example, the CGC has proposed the RIOT initiative, a project that would develop rapid, instrumental and objective testing technologies such as infra-red analysis, image analysis, and mass spectroscopy.

2.3 The Number of Segregations (Wheat)

The number of segregations in the GHTS has been increasing. A growing number of special crops, the introduction of transgenic canola varieties and other identity preserved (IP) shipments of grain have contributed to this expansion. In addition, the number of CWB segregations has increased substantially over the last decade, largely as a result of finer protein increments and variety-specific contracts.

Customer demand for more specific grain characteristics is driving the trend towards increased segregation of grain. Grades, off-grades, protein content and identity preservation are several factors that contribute to the number of segregations in the grain handling and transportation system.

As an illustration of this trend, in the 1985-86 crop year, the CWB listed initial prices for 156 wheat and durum wheat segregations. In the 1998-99 crop year, there were 429 prices listed, a 175% increase over the 13 year period. However, it is important to note that the items on the list are not necessarily binned separately. For example, although 1CWRS has eight protein designations, ranging from a base grade (11.5% protein or less) to 15.0%, primary elevators generally blend these 1CWRS products into two or three separate bins. For instance, truckloads of 1CWRS 13.0% and 1CWRS 14.0% can be blended together to create a 1CWRS 13.5% product.

It should also be noted that not all segregations are in the system at the same time and different segregations are often blended at various stages to the reduce the need for separate binning.

(a) Grades, Off-grades

There are currently a total of 20 primary grades and two experimental grades of wheat in western Canada. These grades are presented in Table 1. In addition, wheat may be assigned one of several off-grades as defined in the Off-Grades of Grain and Grades of Screenings Order.

Table 1: Primary Grades of Western Canada Wheat and Durum Wheat

Class name	*Grades*	*Variety (from the Regulations)*
Canada Western Red Spring	No.1 CWRS No.2 CWRS No.3 CWRS	Any variety of Red Spring wheat equal to or better than Neepawa.
	CW Feed	Any varieties of wheat excluding Amber Durum.
Canada Western Amber Durum	No.1 CWAD No.2 CWAD No.3 CWAD No.4 CWAD	Any varieties of Amber Durum wheat equal to or better than Hercules.
	No.5 CWAD	Any varieties of Amber Durum wheat.
Canada Western Red Winter	No.1 CWRW No.2 CWRW	Any variety of Red Winter wheat equal to acceptable reference varieties.
	CW Feed	Any varieties of wheat excluding Amber Durum.
Canada Western Soft White Spring	No.1 CWSWS No.2 CWSWS No.3 CWSWS	Any variety of Soft White Spring wheat equal to acceptable reference varieties.
	CW Feed	Any varieties of wheat excluding Amber Durum.
Canada Western Extra Strong	No.1 CWES No.1 CWES	Any variety of extra strong Red Spring wheat equal to or better than Glenlea.
	CW Feed	Any varieties of wheat excluding Amber Durum.
Canada Prairie Spring White	No.1 CPSW No.2 CPSW	Any variety of Canada Spring White wheat equal to acceptable reference varieties.
	CW Feed	Any varieties of wheat excluding Amber Durum.
Canada Prairie Spring Red	No.1 CPSR No.2 CPSR	Any variety of Canada Spring Red wheat equal to acceptable reference varieties.
	CW Feed	Any varieties of wheat excluding Amber Durum.
Canada Western Experimental	No.1 CW Exprmtl No.1 CW Exprmtl	Any variety approved by Agriculture Canada for experimental purposes.

Source: Canadian Grain Commission, Official Grain Grading Guide, August 1, 1998.

Each of the 22 regulatory grades may be assigned a tough or damp off-grade designation if it contains excessive moisture. Wheat of any class containing specified grading factors in concentrations higher than that allowed in the lowest regulatory grades may be assigned one of several off-grades. Two examples of off-grade designations are (a) a shipment of 2 CWRS with a moisture content in excess of 17% would be designated as "2 CWRS Damp", and (b) a shipment of 1 CWAD that contains stones but not in excess of two and one-half percent would be graded as 1CWAD Rejected-Account Stones/in excess of two and one-half percent would be graded as 1CWAD Sample Salvage.

It is unlikely that all of the grade, off-grade combinations will occur within a given crop year but it is important for quality assurance that they are in place. Year-to-year variations in growing conditions make it necessary to have a wider range of segregations than are necessary in a single year.

Within established rules and regulations, terminals can choose to bin various grades together. Most off-grades are forwarded to terminals and are handled in the primary elevator and transportation system like other grades. The grade assigned at terminals provides appropriate payment, but the terminal, in most cases, blends these off-grades immediately or soon after receipt.

(b) Protein

Protein content is an important end-user specification for wheat and durum wheat that requires separate binning and is applied at several grade levels. Producers are paid for the top two grades of CWRS for every 0.5% increment, from 11.0% to 15.0% protein. For 3CWRS, they are paid for every 0.5% increment from 12.0% to 13.0% protein. Payments, for the top two grades of CWAD, are also made at 0.5% increments over a range, from 12.0% to 14.0%.

These protein payment levels increase the potential number of wheat and durum wheat segregations in the GHTS. However, as described earlier, the number of physical segregations on account of protein content is considerably less than the number of protein payment levels.

(c) Identity Preserved

A growing number of identity preserved (IP) grain shipments are entering the grain handling and transportation system and adding to the number of segregations that must be handled. IP grain programs deliver a specific quality to the end user that can not be expressed by a single-valued description, a grade or by simple measurements. Combinations of an official grade, a variety name and other descriptors are used to identify these shipments.

"No.1 CWAD (14.0) AC Melita" is the Canadian Wheat Board (CWB) designation for one of the 16 variety-specific contracts that the CWB has for wheat and durum wheat. In this example, the official grade (No.1 CWAD), the protein content (14%) and the name of a durum wheat variety (AC Melita) are used to specify an identity preserved grain.

2.4 Segregations Received at Port

Not all of the segregations that result from the variety of grain, the grading system, protein content and other characteristics that require a shipment to be binned separately, enter the grain handling and transportation system at the same time.

The grading system and other segregation criteria allow for a wide range of products to be identified to meet the customers' specific needs and accommodate yearly variations in growing conditions. Marketing and climatic factors influence the number of segregations that will enter the grain handling and transportation system during the course of a given crop year.

In the 1996-97 crop year, of the 345 possible segregations of wheat in the CWB payment schedule, only 155 and 112 were received at Thunder Bay and the west coast ports, respectively. Table 2 shows the number of segregations received at the west coast, Thunder Bay and Churchill port locations for the 1992-93 to 1996-97 crop years. There is a wide fluctuation in the number of segregations over the years and, in some years, a distinct difference in the number of segregations received at Thunder Bay relative to the west coast ports. This yearly fluctuation in the number of segregations received is primarily due to growing conditions. For example, in a year with excess moisture during the pollination stage and again at harvest, there will be an increase in the number of receipts graded "sample account fusarium damage" and tough or damp.

Table 2: Total Number of Segregations Received Annually at Port Locations

	1992-93		*1993-94*		*1994-95*		*1995-96*		*1996-97*	
	Wheat*	All Other Grain	Wheat*	All Other Grain	Wheat*	All Other Grain	Wheat*	All Other Grain	Wheat*	All Other Grain
Thunder Bay	69	89	98	144	126	117	100	96	155	97
West Coast	81	88	90	119	103	97	107	100	112	100
Churchill	6	2	4	2	9	0	13	1	15	0
Total	156	179	192	265	240	214	220	197	282	197

Source: Compiled by AAFC, based on Canadian Grain Commission Data.
*Includes durum wheat.

The variation between ports is due to a number of factors including, but not limited to, growing conditions and types of crops grown in the catchment areas for each port and

the markets serviced by each port.

It is important to remember that a large proportion of these segregations received at a port are small volumes of one and two car loads. In the 1996-97 crop year, 39 out of the 155 segregations of wheat received at Thunder Bay were for less than 180 tonnes (90 tonnes per car load). These small quantities could quickly be blended with an appropriate grade thereby freeing up bin space.

2.5 Segregations in Store

The number of segregations in store at any given time is related to elevator capacity, i.e. the number of bins. The greater the number of bins, the more segregations the elevator may handle. With an increase in the number of segregations in store, the amount of usable bin space decreases and the elevator's ability to handle new deliveries decreases. This may result in fewer receipts being handled, a reduced turnover ratio and increased average operating costs.

In the 1988 study titled “The Cost of Grade Segregations to Primary Elevators”, it was reported that the average annual number of grains and grades received at primary elevators was 5 and 20.8, respectively[2]. The study also reported that only 8.5% of elevators received 35 or more segregations. On average, the elevators in the CGC study sample had 47 bins. Depending on the timing of grain deliveries, each bin in an elevator could contain as many as 20 different segregations over the course of a year.

In 1995, the CGC conducted a similar study for terminal elevators using data from the 1982-83, 1983-84 and 1984-85 crop years. The average number of grains handled at terminal elevators in Thunder Bay was 5.3, Vancouver had an average of 5.7 and, for the entire data sample, the average number handled was 5.4. The average number of segregations handled for the entire sample was 32.3 per month. In Thunder Bay, the average number of segregations handled per month was 33.6 while in Vancouver it was 28.4. The average number of bins for the entire data set was 369 bins per elevator. In Thunder Bay, the average number of bins per elevator was 440, while in Vancouver the average number of bins per elevator was 259.

Due to the age of the data used in the CGC study, one should not assume that these values would be the same today. The data does illustrate that despite a large number of segregations of grain that a terminal elevator may receive (an average of over 200 segregations annually), not all of these segregations are in the grain handling and transportation system at any given point in time.

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[2]Based on three crop years of data ending in 1985/86 for 1,748 elevators.

One point that needs to be stressed is the fact that although a significant number of segregations enter the handling system, a much smaller number (approximately 150 or fewer) of segregations are shipped from the port. For example, in the 1996-97 crop year, only 43 segregations of wheat and durum wheat were shipped from the west coast compared to the 112 that were received. A large number of these are cleaned, conditioned and/or blended by the terminal operators to improve the efficiency of the system.

2.6 Elevator Consolidation

The Canadian grain handling and transportation system is being rationalized at a rapid pace. Numerous lower volume, low throughput primary elevators are being replaced by high volume, high throughput facilities. Industry analysts predict that the greatest level of consolidation could result in a system with as few as 200 high throughput primary elevators rather than the current 1,143 elevators (of which approximately 1056 are smaller wooden elevators).

An indication of the speed at which the prairie elevator system is presently being rationalized can be seen in the Saskatchewan Wheat Pool's (SWP) recent announcement on elevator closures. SWP indicated that within the next two to three years they planned to close 235 elevators at 170 delivery points. In effect, approximately 12 older wooden elevators would close for every high throughput elevator SWP plans to build.

Two opposing forces are at work with regard to the system's ability to handle an increasing number of segregations, when the system is rationalizing in this manner. These two opposing forces are the number and size of bins for the catchment area and maximizing elevator throughput.

As elevators close, the remaining facilities source grain from a larger, more diverse growing region. This could potentially increase the number of segregations handled at a single location with fewer bins available. This rationalization may impede the system's ability to handle an increased number of segregations.

Increased throughput can, to a certain extent, counteract limitations caused by a reduction in the number of bins available in a catchment area. Throughput capacity of the primary elevator system is more a function of turnover than of storage space so the rationalization process does not, by itself, mean a reduction of throughput capacity. With the system increasingly relying on maximizing throughput to reduce costs, it will be critical to have an effective logistics program in place from the farm through to the vessel or end-user.

2.7 CWB Contract Calls

The logistics system that the CWB uses to source grain for its export sales commitments is crucial to the efficient operation of the entire grain handling and transportation system. Board grains, on average, account for 80% of the total volume of grain exported from Canada.

Farmers can deliver their Board grains in two ways (a) acreage based delivery calls or (b) producer delivery contracts. *Acreage based deliveries* provide farmers with the opportunity to deliver grain early in the crop year before they enter into contracts and often before they know the grade and quantity of their new crop. These calls are usually terminated after most farmers have had an opportunity to deliver. Producers are eligible to deliver 40 kg. (1.5 bu.) of grain per assigned acre before reverting to a system of contracting with the CWB. The bulk of the Board grains are brought into the system through a series of *producer delivery contracts*. Following the contract signing deadline date, the CWB knows the tonnages of specific grades that farmers would like to deliver. These tonnages are then compared to the tonnages that will be needed to meet firm and expected sales requirements within the anticipated handling system capacity. By comparing these two figures, the CWB will be able to announce, within 18 days of the contract deadline, the percentage of grain offered under that contract series that will be called for delivery during the crop year.

The following example is an illustration of the producer delivery contracts. On August 27th, 1997, the CWB announced contract calls for 124 train runs for 1, 2 and 3 CWRS and 1, 2 and 3 CWAD, for all protein and moisture (straight, tough and damp) levels. The volume requested was 20% of what farmers had offered under the Series A contract. On September 4th and 12th, contract calls were made for 20% of the same grades on an additional 43 and 46 train runs, respectively[3]. The termination date for these three calls was February 27, 1998. This series of contract calls, in effect, opened a seven-month window for farmers to deliver up to 108 possible segregations totaling approximately 2.6 million tonnes of wheat. By December 5th 1997, a six-month window was opened for an additional 20% (or 2.6 million tonnes) of 1, 2 and 3 CWRS and 1, 2 and 3 CWAD for all protein and moisture levels.

The contract closing dates vary annually. Table 3 provides the CWB contract closing dates for the various grain series for the 1997-98 crop year.

[3]There are a total of 217 train runs.

Table 3: CWB Contract Closing Dates, 1997-98

Series	*Sign-Up Deadlines*
Series A CWRS only	September 19, 1997
Series A	October 31, 1997
Series B	December 31, 1997
Series C	February, 27, 1998
Series D	May 29, 1998

CHAPTER 3 THE BENEFITS OF GRAIN SEGREGATION

This section shall identify some of the qualitative benefits of grain segregations to the stakeholders in the Canadian grain industry and quantify the benefits realized by producers.

3.1 Qualitative Benefits

(a) Symmetry of Information

Grain segregation within the grain handling and transportation system facilitates communication between the buyers and sellers of grain. Buyers are assured of specific characteristics/qualities of the grain they buy. In providing sufficient quality divisions, it permits buyers to choose grains according to their needs and their end-use products. Additional specific grade segregations permit more specific characteristics to be identified. Thus, segregations enable producers to target their production to the desired qualities of the buyer.

(b) Premiums

Grain segregation also facilitates charging premiums for higher quality grain. The result is a greater total revenue is extracted from the marketplace.

(c) Blending

Grain segregation enables elevator managers to blend various grades of grain (within the established regulations) to bring a lower grade lot up to the standard of the next grade by mixing with a higher grade lot that surpasses the minimum standard levels. The result is an increase in the volume of higher quality grain and an increase in the revenue received for the grain.

(d) Marketing

Canada’s entire quality assurance system, including segregation, enables a customer to obtain the same quality on a consistent basis over time. This reduces marketing costs and may contribute to maintaining or enhancing Canada's market share. The grading system and segregation also enables transactions to occur without the grain being physically present during sales negotiations.

3.2 Quantitative Benefits to Producers

The methodology used to quantify the benefits of segregation was to calculate the average annual per tonne returns realized from the actual segregation system in place for CWRS and CWAD during the 1992-93 to 1996-97 crop years and compare these returns to the returns that would have realized had the system had fewer segregations.

Table 4 lists the number of segregations of CWRS and CWAD identified in the CWB price schedule for 1992-93 to 1996-97.

Table 4: CWB Schedule of Segregations - CWRS and CWAD

	% Protein	*1992-93*	*1993-94*	*1994-95*	*1995-96*	*1996-97*
1 CWRS.	Base	X	X	X	X	X
	12				X	X
	12.5				X	X
	13			X	X	X
	13.5	X	X	X	X	X
	14			X	X	X
	14.5	X	X	X	X	X
	15				X	X
2 CWRS	Base	X	X	X	X	X
	12				X	X
	12.5				X	X
	13				X	X
	13.5	X	X	X	X	X
	14				X	X
	14.5				X	X
	15				X	X
3 CWRS	Base	X	X	X	X	X
	12.5				X	X
	13					
1 CWAD	Base	X	X	X	X	X
	12.5				X	X
	13		X	X	X	X
	13.5				X	X
	14				X	X
2 CWAD	Base	X	X	X	X	X
	12.5				X	X
	13		X	X	X	X
	13.5				X	X
	14				X	X
3 CWAD	Base	X	X	X	X	X
	13					X
4 CWAD	Base	X	X	X	X	X
5 CWAD	Base	X	X	X	X	X
No. Of Segregations		11	13	15	31	32

In 1992-93, there were two protein specific payments for 1 CWRS--one was for 13.5% and the other for 14.5%. There was also one protein specific payment for 2 CWRS. In 1996-97, there were seven protein specific payments for 1 CWRS, seven protein specific payments for 2 CWRS, and one protein specific payment for 3 CWRS. For CWAD, in 1996-97, there were four protein specific payments for each of 1 CWAD and 2 CWAD and one specific protein payment for 3 CWAD.

Scenario 1: Actual Revenue Realized, 1992-93 to 1996-97

To calculate the annual revenues realized for Canada Western Red Spring wheat and Canada Western Amber Durum wheat, the CWB final prices were multiplied by CGC reported total export shipments from Thunder Bay, Churchill and the west coast ports (see Tables A and B in Appendix 2). The final CWB prices for a specific protein content were multiplied by actual tonnage of the that protein content that was shipped ($P_{1996} \times V_{1996}$) to yield the return for that specific grain.

Scenario 2: Potential Revenue Assuming No Protein Segregations, 1992-93 to 1996-97

Revenues were calculated on the assumption that there were no protein payments. All volumes for 1, 2, 3 CWRS and 1, 2, 3, 4 and 5 CWAD regardless of their protein content were multiplied by the final prices for 1, 2, 3 CWRS and 1, 2, 3, 4 and 5 CWAD, respectively. This calculation therefore assumed that these prices would remain the same in the absence of protein segregations.

The Results

The total revenue realized was divided by the total tonnage shipped for each of the scenarios, grade and year to yield an average per tonne revenue. Base calculations (scenario 2) were compared to revenue realized according to the CWB schedule of protein in each year from 1992-92 to 1996-97 (scenario 1). Nominal prices (not adjusted for inflation) were used in all the calculations of benefits.

From Table A in Appendix 2, one can see that in 1996-97 the total revenue from No. 1 Canada Western Red Spring wheat was $1,144.7 million or an average of $219.27/tonne. The base price for No. 1 CWRS was $208.20/tonne. One could therefore conclude that the difference, $11.07/tonne, represents the added revenue realized from having protein segregations.

Based on the calculations contained in Tables A and B of Appendix 2, Table 5 summarizes the increases in revenues that are attributable to the specific payments made by the CWB to producers for the years 1992-93 to 1996-97.

Table 5: Increases in Average Revenue Due to Protein Segregations, $/tonne

Grain	*1992-93**	*1993-94**	*1994-95**	*1995-96**	*1996-97**
1 CWRS	$5.22	$1.50	$3.50	$12.46	$11.07
2 CWRS	$1.55	$1.81	$2.60	$9.69	$10.81
1 CWAD	$0.00	$1.85	$0.00	$1.65	$ 0.13
2 CWAD	$0.00	$0.64	$0.00	$0.07	$ 0.00

*Note: Averages are weighted by volumes.

Table 6 compares the overall average increase in returns for 1995-96 to 1996-97 and 1992-93 to 1994-95. The CWRS average increase in returns for 1995-96 to 1996-97 are notably higher than averages calculated for 1992-93 to 1994-95. This is attributable to the introduction of more protein payment levels, and the larger protein premiums offered in 1995-96 to 1996-97. On average, there were ten more protein payment levels in 1995-96 to 1996-97 than in 1992-93 to 1994-95. For CWAD, on average, there were eight more protein payment levels in 1995-96 to 1996-97 than in 1992-93 to 1994-95. The CWAD average returns above base grades appear less significant. However, the premiums for specific protein levels in CWAD are as significant as the premiums for specific protein levels in CWRS. The average returns for CWAD above the base grades are lower than those for CWRS because the shipments of CWAD with a specific protein level account for a much smaller proportion of the total shipments of CWAD than is the case for CWRS.

Table 6: Average Increase in Producer Returns due to Protein Segregations, $/tonne

Grain	*Average of 1992-93 to 1994-95**	*Average of 1995-96 to 1996-97**
1 CWRS	$4.00	$11.70
2 CWRS	$2.13	$10.29
1 CWAD	$0.21	$ 0.66
2 CWAD	$0.14	$ 0.04

*Note: Averages are weighted by volumes.

Although the calculations, in Table 5 and Table 6, show an average dollar per tonne increase in producer returns, the benefits that individual producers realize for CWAD and CWRS are specific to the wheat grade, class and protein content they deliver and may be different from the averages calculated here. For example, in the 1996-97 crop year, the final CWB price for 1 CWRS ranged from $208.20/tonne for the base grade of

1 CWRS to $242.02/tonne for 1 CWRS 15% protein content.

Because the calculations used primary and transfer shipments from Thunder Bay, Churchill and the west coast for the volumes, the results would not reflect all volumes of CWRS and CWAD delivered into the grain handling system. In effect, the volumes for domestic usage, original primary deliveries that had been blended, off-grades and prairie-direct shipments to the U.S. plus other volumes not shipped from the three ports were omitted in these calculations. US exports, in particular, can represent up to one half of the high protein durum wheat shipments. By not including these data, the results may result in an *underestimation of the benefits of segregating*. In addition, the results do not reflect the benefits realized from increased sales associated with more segregations.

CHAPTER 4 THE COSTS OF GRAIN SEGREGATION

The previous section focussed on the benefits of grade segregations to the producers. However, this provides only part of the picture as one must consider the added costs associated with adding segregations to the grain handling and transportation system as these segregations affect all operations from farm gate to export vessels. The benefits of increased segregations must be weighted against the cost imposed onto the system to determine if there is a net increase in benefits to the system and producers.

The costs associated with additional segregations of prairie grains are varied and affect nearly all components in the grain industry. These additional costs are, for the most part, difficult to separate from the costs that would exist with fewer segregations. This section will not attempt to quantify these additional costs but, rather provide a discussion of the nature of these costs and their effects on the system. Summaries of studies investigating the factors affecting elevator costs and efficiencies, including the number of segregations, are contained in Appendix 1. Cost data and other relevant information from these studies will be presented and discussed in this chapter, where appropriate.

The number of different grains produced in western Canada, and the number of grades established under the grain grading system play a large part in determining the number of segregations that must be managed throughout the transportation and handling system. The costs associated with additional segregations may include reduced handling efficiency (which results in increased operating costs and congestion) and increased storage costs associated with less effective use of bin space.

4.1 Costs to Primary and Terminal Elevators

Storage and elevator congestion are integral in the discussion of operating costs to primary and terminal elevators. Elevators have to handle and store not only the base grades designated under the Canadian grain grading system, but also off-grades and condemned grains as well. The result of storing the latter, according to a study by McKeague, Lerohl and Hawkins[4], is a reduction in capacity turnover at terminal elevators by more than 15%. Turnover ratios are commonly used as a proxy for elevator throughput. A decrease in the turnover ratio results in higher average costs that must be either absorbed by the elevator company or transferred to the producer through higher tariff rates.

[4] D.V. McKeague, M.L. Lerohl and M.H. Hawkins, The Canadian Grain Grading System and Operational Efficiency Within The Vancouver Grain Terminals, Agribusiness, Vol. 3, No. 1, 1987, pp. 19-42.

Elevator congestion, or the inability to handle further amounts of grain, is a result of several factors including off-grade grains, small amounts of base grade grains, misshipped grains (i.e. grains not required to meet immediate sales using valuable bin space), shipping delays and a lack of export sales.

Since elevators are characterized by significant fixed costs, reducing the throughput will increase the average cost to handle each tonne of grain and may result in increased elevator tariffs. For example, Askin's[5] research indicates that a 10% reduction in receipts (turnover) at the primary elevator would result in an 6% increase in average total costs.

The new, larger, high throughput elevators are located farther apart and can handle larger volumes of grains. The industry anticipates these elevators to have capacity turnover ratios of 10 to 15. However, these high throughput elevators cost up to 40% more to build per tonne of capacity, leading to a higher fixed cost. The renewed primary elevator system will contain fewer elevators with larger bins and less storage capacity in total than ten years ago. This will probably increase the demand on elevator storage, and may cause a trend towards greater on-farm storage. However, the average operating costs for primary elevators will probably decrease. According to Askin, "If average elevator capacity increases by 10%, while the total system capacity remains unchanged (which is becoming a reality through the elevator rationalization process), the average operating costs (at primary elevators) would fall by about $0.17/tonne."

In a subsequent Canadian Grain Commission report, it was stated:

> "A 10 percent increase in the number of grades handled (at the Port of Vancouver terminal elevators) is expected to result in a 2.57 percent increase in average operating costs, all else constant."[6]

Applying this finding to a 27.7 percent increase in the number of segregations received at west coast terminals between 1992-93 and 1996-97 would suggest an increase in the average operating costs of 7.1 percent over the same period.

The Canadian Grain Commission report also stated that operating costs at Thunder Bay would not be significantly affected by an increase in the number of segregations as these elevators have been designed and constructed as efficiently and cheaply as possible to handle the numerous segregations they receive. McPhee stated that the

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[5] Tom Askin, The Cost of Grade Segregations to Primary Elevators, Canadian Grain Commission, 1988, p. 2.

[6] Terry Lynn McPhee and Anita Bourget, Cost of Grain and Grade Segregations at Terminal Elevators in Canada, Canadian Grain Commission, 1995. Pg. 69.

cost to Thunder Bay comes in the form of capital costs that were incurred during the construction of terminal elevators with increased storage requirements.[7]

Construction costs for elevators can vary greatly depending on the sophistication of equipment and technology. Another cost variable involves the number of storage bins designed for a new primary elevator. For example, a report by Demmans and Roth indicated that a 20,000 tonne concrete facility with a 35 storage bin design could cost approximately $1 million more than a 20,000 tonne facility with a 14 storage bin design.[8] Generally, grain segregations can be more efficiently managed in a primary elevator with a higher number of storage bins.

The industry has raised concerns over the west coast capacity constraint (the Port of Vancouver) which may be complicated by increases in the number of grain segregations.

4.2 Costs to Railways

The CWB and elevator companies, through the car allocation system, have considerable input into train runs and the service provided at each elevator in any given week. The cost of rail transportation, however, is primarily borne by the producer. With a greater number of segregations there is more complexity and greater possibility that the wrong segregation could be moved at the wrong time.

The issue of the extra rail car cost associated with the multiplicity of grain segregations is a debatable question according to Demmans and Roth. It may be argued there has ultimately been no extra rail cost to farmers. However, with increased segregations there may be some need for additional switching of rail cars by the railways which must be balanced against the less efficient use of terminal capacity that could result if these segregations were spread throughout the terminals.

4.3 Costs to the CWB and Producers

The CWB plays an integral role in the current grain handling and transportation system. For example, CWB contract calls are used to regulate the flow of the required grains, grades, and proteins from the farm to the port to meet sales requirements which generally results in the improved efficiency of logistics at port. This is, however, complicated at times by the number of participants in the system.

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[7] Terry Lynn McPhee and Anita Bourget, Cost of Grain and Grade Segregations at Terminal Elevators in Canada, Canadian Grain Commission, 1995.

[8] Clarence Roth and Maurice Demmans, Meeting Customers' Quality Requirements with Quality Segregations, CJR Consulting Ltd. and M.D. Demmans Holdings, 1998. Pg. 55.

The historical operating costs of the CWB (see Table 7) give an example of some of the annual costs that are partly due to the multitude of grain segregations. These costs are ultimately paid by the farmer in the form of lower net returns from the CWB pool accounts.

If, for example, additional segregations delay the delivery of grains to port, demurrage costs could increase if a vessel is required to wait until adequate stocks are built up. Of course, the number of segregations is not responsible for all demurrage charges (some are incurred due to insufficient producer deliveries to the primary elevators, poor weather conditions and other factors during the crop year).

Table 7: CWB Annual Operating Costs for Wheat (Including Durum), $/tonne

Wheat (Including Durum)	*1994-1995*	*1995-1996*	*1996-1997*
	$/tonne		
Country Elevator Carrying Charges	$3.19	$3.68	$2.89
Terminal Storage	$1.01	$0.88	$0.84
Demurrage / Despatch	$0.27	$0.49	$0.85

Source: CWB Annual Reports 1995-96 and 1996-97

On-farm storage must also be considered as a cost to producers. If producers are to take advantage of the additional segregations available, they may require additional on-farm storage space for these new segregations. Currently, western Canadian farmers have an on-farm storage capacity of 62 million tonnes. This total capacity is slightly higher than annual crop production.

When determining the optimal amount of on-farm storage, producers must carefully consider whether to invest in a few larger, lower cost per bushel storage bins or several smaller, more expensive per bushel storage bins to manage their grain segregations. In addition to the individual farmer having to consider the types of crops he will grow and the need for binning various grades/segregations, different geographic regions throughout the prairies also will have varying needs for additional storage capacity.

Some industry representatives are calling for a reduction in the number of segregations that are currently being used. They believe that it will reduce elevator congestion, reduce storage costs and provide for a more efficient grain handling and transportation system. However, a reduction in the number of segregations or even changes in the grading system to increase throughput will not, on its own, achieve these goals. Many other issues must also be addressed, such as matching terminal receipts to vessel arrivals.

The most desirable and efficient number of grain quality segregations depends on the benefits and costs associated with the additional segregations. Each additional segregation generally results in diminishing marginal returns and increasing marginal costs. The impacts of increasing the number of segregations are felt throughout the grain handling and transportation system, from contracting and arranging deliveries from the farm gate to the final port position.

The costs of additional segregations stem from the increased difficulty in handling products that must be differentiated and kept separate throughout the system, rather than treating the grains as one homogeneous commodity. The processes of contracting and arranging delivery for grain with specific characteristics may result in logistical difficulties for the entire system, potentially causing congestion. These factors may reduce the efficiency of the system and result in increased costs and decreased throughput. The CWB is addressing this issue through tendering for specific grains with characteristics that are not identifiable through the grading system, such as malting barley, and by issuing separate contract calls for varieties such as Glenlea and AC Melita.

Unlike the benefits from higher prices that are passed back to those producers who participate in a CWB pool account, many of the costs associated with additional segregations are distributed over the system and paid by all producers. As well as increased handling and transportation costs, increased marketing costs and losses due to missed sales also are costs which all producers share.

With the information currently available, it is not possible to determine if and to what extent the benefits realized by the prairie grain producers outweigh the added costs. Further research is required into both the costs and the benefits of the present system to determine the optimal number of segregations and the impact of adding segregations.

CHAPTER 5 RELATED CONCERNS

5.1 Identity Preservation

Identity Preserved (IP) grains may result in additional strains on the grain handling and transportation system. These grains must be binned separately from the farm to the final consumer. Qualities and specific traits that merit identity preservation include organic products, high protein (wheat), and high oil content (corn).

Buyers of IP crops, may in the near future, require certification of quality or product safety levels by an internationally recognized program such as International Organization for Standardization (ISO) certification or Hazard Analysis Critical Control Points (HACCP) certification, to name a few.

There are several examples where buyers of Canadian grain are making their purchases based on specific grain quality specifications that are not reflected in the current grading structure. Some examples include the following:

Warburtons Mills -This U.K. flour miller/bakery is purchasing only specific wheat varieties grown in western Manitoba and eastern Saskatchewan that provide them with a more consistent and better quality product. Warburton is contracting with Manitoba Pool Elevators and N.M. Paterson & Sons who are the agents for the Canadian Wheat Board in terms of grain origination in the country. Warburtons' contract requirements for 1997/98 are in the order of 100,000 tonnes. The company has opened a testing laboratory and office in Brandon, Manitoba and plans to construct an additional two bakeries in the U.K. by 1998/99. Warburtons' requirements may have the potential to increase substantially over the next few years.

ConAgra -This U.S. company is particularly interested in the Glenlea wheat variety that is registered under the Canada Western Extra Strong (CWES) class. This variety has a strong gluten content and is ideal for the production of frozen doughs and blending with U.S. varieties to raise the gluten strength.

Ellison Mills-This company is a Division of Parrish & Heimbecker that is located in Lethbridge. It is purchasing certain soft white spring wheat varieties with annual volumes in the range of five to ten thousand tonnes.

Other buyers have specific needs which are not always met by the Canadian system. Some buyers have specific requirements regarding residue tolerances (e.g. pesticides, chemicals, mycotoxins) that are not addressed in the current export

standards. Some countries, such as India and Sri Lanka, are said to request moisture guarantees of 13.5 per cent, whereas the current grading standard is 14.5 per cent.

It has been suggested that an alternative to abandoning elevators could be to use these facilities to store and handle identity preserved crops and other speciality grains. These crops also could be moved using containers rather than traditional hopper cars. It is expected that these movements would be more expensive than the current system but, producers of these higher-valued specialized commodities may be willing to accept these higher costs in return for improved delivery opportunities. Removing these lower volume crops from the bulk grain handling and transportation system would allow greater access for the higher volume grains and provide for a more efficient system.

With the increasing popularity of certain crops, such as organically grown grains and Genetically Modified varieties, there will be an additional increase in the number of grain segregations in the near future.

According to Groundwater[9], identity preserved grain is seen by some as a panacea for the future. Changes in the agricultural environment, the structure of the industry, globalization and the technology of agricultural systems are accelerating. As a result, agricultural commodity production, management, transportation, marketing and processing are becoming precision systems to extract the highest value from the marketplace.

5.2 CWB Contract Calls

Contract calls are a mechanism for regulating the flow of the required grains, grades and proteins from the farm to the port to meet sales requirements. Tighter coordination of CWB contract calls with car allocation and vessel arrivals could be used to move into the system only the grain that is needed to meet market demand. With tighter coordination, contract calls could become more specific, in terms of the number of grades, protein segregations, train runs and time frames that would apply for each call.

Delivery equity among producers is a concern with this type of system. Certain producers, by way of a specific contract call, could be excluded from delivering their grain based on location, grade and or protein content. Storage payments to producers may be the solution to delivery equity with tighter contract calls. The amended Canadian Wheat Board Act has provisions that allow the Board to make payments to producers for wheat and barley stored on the producer's farm, in addition to the cash advances program.

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[9]R.A. Groundwater, Http://www.canadagrainscouncil.ca/ground~1.htm.

5.3 Additional CWB Protein Segregations

As of August 1st, 1999, producers will be paid premiums by the CWB for each one-tenth of a percentage increase in protein for CWRS and CWAD wheat. Currently, the payments made to producers are based on every half of a percentage increase in protein. The further sub-division of these increments is intended to reflect more precisely to producers the incremental value of the protein content of their wheat. However, there will not be a separate physical segregation for each of the protein levels, i.e. many of these deliveries will be blended at the primary elevator. Given that this change may increase the total number of wheat and durum wheat segregations slightly, it is an important change that could have an impact on the total grain handling and transportation system.

CHAPTER 6 CONCLUSION AND AREAS FOR FURTHER STUDY

6.1 Conclusion

The objective of this paper was to provide an overview of the implications of increased segregations within the grain industry in western Canada.

The number of segregations have increased considerably in recent years on the prairies and at the ports. This has provided producers with additional revenues through higher prices obtained for some segregations. The average increase in producer revenue for #1 CWRS for 1995/96 to 1996/97 due to protein segregations was estimated to be $11.70/tonne more than if there had been no protein segregations.

Along with these increases in revenue, there are increases in costs due to increased storage and handling of the segregations. Most of these costs are initially incurred by the grain companies and relate to the need for additional storage and reduced handling efficiency. There are also additional management costs incurred throughout the system. All of these cost increases impact producers.

Several areas that will be of increasing concern in the future include: identity preservation, CWB contract calls, and additional CWB protein segregations.

6.2 Areas for Further Study

The analysis of the benefits undertaken in this paper was limited to CWRS and CWAD. Further analysis of the impacts of segregations on other major crops, such as canola, would be beneficial. It would also be useful to conduct additional quantitative analysis of the costs associated with increased segregations. This type of analysis would allow a determination of the net benefits/ costs of additional segregations and of the optimal number of segregations.

Another area in need of additional study involves the recent changes to the Canadian Wheat Board Act. In light of the trend towards more on-farm storage as the elevator system continues to consolidate, the provision in the revised Canadian Wheat Board Act to allow for storage payments to producers (in addition to the cash advances program) may provide an incentive for producers to utilize more on farm storage. Perhaps the issue of increased costs and operational problems caused by increased segregations can be dealt with by more precisely calling into the system the grain and grades as needed to meet sales and, in this way, reducing the additional pressures/strains on the grain handling and transportation system from more segregations.

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APPENDIX 1 LITERATURE REVIEW

The Canadian Grain Grading System and Operational Efficiency within the Vancouver Grain Terminals
D.V. McKeague, M.L. Lerohl, M.H. Hawkins
Agribusiness, Vol. 3, No.1, 19-42 (1987)

This study examines the effect of the system of grain grading in Canada on the operational efficiency of Pacific Coast terminal elevators. The analysis is based on a time and motion study carried out for the Alberta Wheat Pool at Pacific Elevators Limited and the Alberta Wheat Pool's terminal elevator facility in Vancouver by Swan Wooster Engineering Ltd., a consulting engineering company.

The study's findings on the effects of grain and grade segregations on the operational efficiency within the Vancouver grain terminals are summarized below.

(a) Unloading and grading
In 1985, approximately one car in three contained a different grain or grade than either the car ahead or the car behind. Increasing the number of cars per lot delivered to the terminals would reduce the number of times the distribution system would have to be reset during the shift.

(b) Weighing
The study does not attribute any potential inefficiencies in weighing practices to the number of segregations handled by the terminals.

(c) Cleaning
An average of 12 minutes per bin load is required to set up the cleaning operations. Allocation of the same wheat grade and protein content to the cleaner would allow for a more continuous flow, thus reducing the set up time. Cleaning is identified as one of the major bottlenecks in Vancouver's terminal operations.

(d) Storage
The study concludes that in addition to terminal capacity the number of bins available is critical to the efficient operation of the terminal. The study found that off-grade and misshipped grains tend to be stored longer than the regular grades handled by the terminal, which lowers the number of times terminal elevator space is turned over. The study also found that the time required to build up an average size shipment varies between grains, and that the greater the number of segregations, the longer the time required to build up stocks for shipment. The study suggests that the terminal elevator space could be more effectively used if the number of grades received was reduced.

(e) Shipping

Finally, the study suggests that small parcels of grain in the terminal may lead to demurrage charges if a vessel is required to wait until adequate stocks are built up.

The authors of the study caution that potential increases in throughput identified in the study may only be achievable if vessel arrivals are scheduled to ensure that there is a continuous flow of grain through the terminal.

The Cost of Grade Segregations to Primary Elevators:
Tom Askin
Canadian Grain Commission, 1988

This study uses an econometric approach to investigate the relationship between costs at primary elevators and the number of segregations handled. Factors including receipts, capacity, the number of bins, the number of grains and grades received, the percentage of receipts in the top five grades, the type of manager unit, and turnover are analyzed for their relationship to average operating costs, average total costs, and total costs in primary elevators.

Using regression analysis, the report estimates that an increase (decrease) of 2 grades from the average (20.8) is related to an increase (decrease) in average operating cost of about $0.05/tonne, an increase (decrease) in average total cost of about $0.13/tonne, and an increase (decrease) in total cost of about $2,600 per elevator per year.

According to the study, other factors, such as turnover, have a greater impact on costs than does the number of grades. A 10% increase in turnover rate is estimated to reduce average total costs by approximately 6%. Decreasing the capacity of a 30 million tonne handling system by 10% while keeping receipts constant (i.e. increasing turnover) is estimated to reduce average total costs by $0.65/tonne.

Greater capacity and subsequently higher receipts are also related to lower average operating costs for individual elevators. An increase of 10% in elevator capacity (without increasing the total capacity of the system), taking into account the increase in receipts that would accompany the larger capacity, would reduce average operating costs by $0.17/tonne, for a 30 million tonne handle. It was also noted, however, that those elevators with greater capacities tended to have lower turnover rates, suggesting that larger elevators are underutilized.

A major limitation identified in this study is the difficulty in directly linking the grading structure to the average number of grades handled by primary elevators. A change in the number of segregations in the system may have little effect on operations of

many primary elevators because of variable grain production patterns in the local catchment area.

Another consideration which may limit the usefulness of the report is that the data (and the resulting analysis) has been based on an elevator system that has been designed and built to accommodate the number of grades expected. A change in the grain grading system would result in certain short-run cost effects and very different long-run cost effects, as the handling system adjusts to the grading system. These long-term effects are difficult to estimate.

This study also investigates only the costs associated with the primary elevator system and does not include other system operations such as transportation and terminal elevator operations.

Cost of Grain and Grade Segregations at Terminal Elevators in Canada: Draft Report:
Terry Lynn McPhee and Anita Bourget
Canadian Grain Commission, 1995

This study uses a set of models to attempt to quantify the relationship between the number of grains and grades handled and the operating costs and throughput of the terminal elevator handling system. In the average operating cost model, factors including receipts, the number of grains and grades received, the number of grades in store, and elevator capacity are analyzed for their relationship to monthly average operating costs. The elevator throughput model investigates the relationship between monthly turnover at terminal elevators (a proxy for throughput) and the number of grade segregations handled.

According to the results gained through regression analysis in the average operating costs model, an increase in the number of *grades* handled would cause a significant increase in average operating costs at Vancouver, while the number of *grains* would have an insignificant impact. At Thunder Bay, the number of *grades* handled did not seem to have a significant effect. The study suggested that this could be an indication that the Thunder Bay terminals were designed to handle the number of grades they receive. It was noted that Thunder Bay terminals have a much larger average number of bins than do Vancouver terminals. An increase in the number of *grains* handled at Thunder Bay did cause a significant increase in average operating costs. Analyses suggested that elevator space is underutilized at Thunder Bay, more so than at Vancouver, and that the fixed portion of average operating costs is higher at Vancouver than at Thunder Bay.

The differences in the results between Thunder Bay and Vancouver suggest that

elevator configuration and design has a significant impact on the ability of the system to handle grain and grade segregations. Consideration of capital expenditures is also important.

The results of the second model indicate that there is an optimal number of grades that maximize turnover rate. In other words, at low numbers of grades, additional grades are positively associated with increased turnover, perhaps due to the corresponding increase in receipts, while at high numbers of grades, turnover is negatively associated with additional grades. Somewhere between these extremes is a point at which turnover is at its maximum. Optimal numbers of grades are calculated in a variety of ways, but discrepancies in the results gained from the regression analysis make it difficult to determine the value of this optimum.

A major limitation identified in this study is the relevance of the data it used in its analysis. The data was taken from 1982 to 1985. Many changes have occurred in the grain handling system since this time. Another limitation is the disconnect between the number of grades in the grading system and the number of grades actually handled in a particular part of the handling system.

This report offers some suggestions for further research, including analysis of the impact of grade segregations on the grain transportation system and the grain handling system as a whole. Other opportunities for research include quantification of the benefits of the Canadian grading system and development of a framework for measuring the costs and benefits to the grain handling system of adding or removing grades and grains.

Automation Case Studies: Practical Considerations. The Prince Rupert Grain Terminal Elevator - Aspects of Automation:
Alex Yovanovich
Proceedings of GEAPS Exchange ‘95

This description of the operation and systems management of the Prince Rupert Grain Terminal provides a thorough overview of the processes through which grain must go at the terminal position. Included in this outline is an examination of performance management procedures, identifying areas of potential inefficiency and lost productivity.

Overhead costs within the terminal are identified as a source of lost productivity. These costs are associated with the time required to set up and purge the equipment before and after the actual processing operation. One of the options that the report offers as a way of reducing overhead costs is to increase batch size and thus reduce the number of times that equipment must be set up and purged within a

given time frame.

Even if the terminal itself is fully optimized, there are external factors that may affect the performance of the terminal. The report again identifies small batches as a source of lost productivity. Since rail cars are generally processed as delivered, consecutive cars containing different grades or grains require the purging and set up of equipment between each car. Lack of incoming product or destination space can also limit performance. These factors are largely beyond the control of the terminal and are linked to the performance of the contracting and delivery system.

Experiences with Value-Added Grains: Testing and Handling:
Dr. Charles R. Hurburgh, Jr.
Proceedings of GEAPS Exchange '97

This article examines some of the issues that the grain handling system in the U.S. must deal with in handling value-added grains through identity preserved shipments and specification marketing. It defines value-added grains as those "that meet individual users' needs through one or more enhanced properties." The discussion outlines some elevator experiences in segregating bulk grains, such as wheat, soybeans and high-oil corn, by specification.

Costs of segregating and testing specification grains are estimated at less than three cents per bushel, for the majority of elevators. In an example based on soybeans, the report estimates that costs are split approximately in half between handling and grading. The increased handling costs are incurred in additional waiting time, labour, misgrades, and losses in receiving. A significant portion of the grading costs are in the purchase of equipment.

Examination of the data suggests that elevators with larger size and handling capacity are generally able to segregate grains more efficiently than smaller elevators. The report states that the success of a segregation system depends on a variety of factors, including consistent and predictable economic formulas, incentives to producers, automated data management, training and personnel skills, professional support, and quality control.

The Future Quality System for Canadian Wheat:
A Discussion Paper by the CWB and CGC, 1997

This article examines the impacts of current and future trends in the grain industry on the quality assurance, or grading, system for wheat. It identifies several areas of development that will have significant effects on the future quality system for wheat.

Biotechnology in plant breeding is identified in the paper as being the area that will likely have the most impact on the quality assurance system in the long-term. The limits of the KVD system of grading will continue to be challenged as biotechnology creates products for highly specialized market needs.

The paper identifies contract registration of wheat varieties for special market demands as being a potential threat to the quality and consistency of Canadian export wheat, as the risk of these "non-conforming" grains entering the bulk system is increased. Additional monitoring and enforcement will be necessary on the part of the CGC in order to ensure that varieties with contract registration are produced and moved in a closed loop system. Closely linked to this issue is the improvement of testing technology, so as to be able to distinguish specialty grains from the bulk classifications. Optical imaging systems are being used to improve the KVD system, and other tests that do not rely on visual characteristics are being developed and refined.

The paper also names the rationalization of the grain handling and transportation system as an important factor in the future of the quality assurance system. It states that the movement toward high throughput elevators is accompanied by declining ability to handle a large number of segregations efficiently, while at the same time, market demands for product differentiation are increasing. Refinement of the rate structures for handling segregations of various volumes may help to increase the efficiency of the system. The consistency of export shipments may be affected by the trend toward large shipments from single facilities, which eliminates the terminal's ability to blend away geographic variations in quality.

The paper goes on to develop several options for a future grain quality assurance system with varying degrees of kernel visual distinguish (KVD) requirements and modified quality parameters. Although the options are developed primarily for discussion purposes, a general conclusion reached is that any system that compromises the Canadian reputation for quality and consistency in wheat shipments is undesirable.

Managing the Increase in Product Segregations:
Interim Report of the Working Group on Multiplicity of Grades

This report outlines possible approaches to the problem of assessing the costs and benefits associated with product segregations and offers suggestions for future research on this subject. The increasing number of segregations is identified as a potential problem for primary and terminal elevators, and as an added cost to producers.

According to the report, the two key aspects of the issue are whether the costs of providing differentiated products to customers are being minimized, and whether the benefits of particular segregations outweigh the costs of handling those segregations.

The minimization of costs is related closely to the information and contracting system that is used to move grain through the grain handling and transportation system. The report identifies the CWB contract calling system and the quality of information on inventories and products required for shipment as the areas that should receive primary consideration. The use of selective tendering by the CWB also could be explored.

According to the report, weighing the costs and benefits of individual segregations could identify a need to eliminate certain segregations. The measurement of these costs and benefits is difficult, however. The working group suggests that an ideal measure of the benefits of segregations would involve calculating the revenue received from two segregations and comparing this to the revenue that would be gained if the two products had been combined into one, taking into account the impact of price signals on production patterns. Since this measure is not possible, the report suggests that price spreads may be used to give clues as to which segregations could possibly be eliminated, but that a significant amount of judgment must be used in estimating the benefits of segregations.

The measurement of costs also is difficult and requires a great deal of information from primary and terminal elevators. The results of two studies done by the Canadian Grain Commission on the costs of segregations in primary and terminal elevators are cited, but it is also noted that "many things have changed since the period studied (1982/83 to 1984/85) so the results very likely do not apply to the current system." The report states that it is likely that the current system would experience higher cost savings from the elimination of segregations than would the earlier system, although no reason for this difference is given.

Meeting Customers' Quality Requirements with Quality Segregations:
Clarence Roth and Maurice Demmans
CJR Consulting Ltd. and M.D. Demmans Holdings, 1998

This study seeks to investigate the impacts of a multiplicity of segregations on the grain handling system, particularly at the primary elevator level. A survey of the international marketplace is provided in order to give a sense of how the Canadian system compares to the competition in this regard. The costs and benefits of segregations are examined through a partial budget analysis and some recommendations for improvement are developed.

Although the study identifies the rationalization of the grain handling system as a potential problem in handling segregations, it does not examine the operations of the system to identify areas in which logistical difficulties and costs may arise. It also does not include costs in the system such as demurrage, ship loading, rail operations, capital and labour in the analysis.

The report states that changes in world markets for grain have generally increased the demand for smaller shipments of grains with specific quality characteristics. Canada's current handling system, which manages segregations on a bulk basis, is strained to keep up with the segregations already moving through the system, and yet the market is demanding more segregations. Canada's success will depend on its ability to consistently provide the types and qualities of product desired by the international marketplace.

Through the cost-benefit analysis, the study concludes that having a system of quality segregation is indeed beneficial to producers. The costs and benefits of an increase or decrease in the number of segregations are dependent on the effect on market share as compared to the change in handling costs. Marginal costs of segregations are estimated in the study to be $0.43/tonne for a low impact scenario and $1.28/tonne for a high impact scenario.

The study assumes that revenue lost due to an inability to handle more grain in periods of congestion is lost permanently. This implies that producers do not ship that grain at all. In reality, most of this grain would make its way into the system eventually.

The study goes on to suggest that it may be beneficial to reduce the number of milling grades in each of the CPS, CWRW, CWSWS and CWES classes to one, rather than two. The addition of segregations for specific quality characteristics, such as very high protein levels or low moisture levels, also could be beneficial.

The study develops recommendations as to how to reduce the costs and increase the benefits of segregations. Improved inspection equipment and techniques, breeding research for higher yields and quality, and the use of genetic markers are among the suggestions for increasing the benefits of segregations. Improvements to the CWB producer delivery contracts and a four-week loading plan are recommended as this would increase accountability, improve system efficiency, and encourage better utilization of information thus reducing congestion and storage time (and therefore, costs) in grain handling facilities. Bringing together the primary and export grade standards into one standard would reduce the number of segregations that a terminal elevator is required to handle.

Two key observations are identified on how to improve the ability of grain

transportation and handling system to deal with a multiplicity of segregations. First, performance agreements should be established between the grain handling industry, railways and the CWB, and second, the efficiency of the movement of grain segregations depends on how grain is stored on-farm, and how it is drawn through the system to end markets.

Board Grain Supply Chain:
Frank Collins, Jan Bowland, and Rob Friend
KPMG Consulting, 1998

This report was commissioned by CN and CP in preparation for the CWB/CN/CP Canada Transportation Agency hearing. It provides a description of the logistics of the board grain supply chain, emphasizing the complexity of the system. The ability of the chain to supply the correct product at the correct time depends on the performance of all participants.

Some previous weaknesses in the supply chain have included congestion in terminals, lack of storage space, unavailability of rail cars and vessels and lack of coordination between marketing activities and system capacity limits, to name a few. Most of the difficulties relate to a need for timely and accurate information sharing.

Several recent sources of added complexity are identified in the study. Changing markets have increased the number of countries to which Canada exports and decreased the amount of grain sold to the top five buyers, signifying a more diverse market. Effective system capacity has been reduced by the increasing diversity of product. The Vancouver terminals handled 104 stock keeping units in January, 1997 compared to 73 in January, 1993. Customer requirements and market factors have increased the need to segregate grain with specific quality characteristics.

APPENDIX 2

Table A

		1996/97			1995/96		
		CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**	CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**
No. 1 Canada Western Red Spring	Base	$208.20	270,557	56,329,866	$254.16	979	$248,746
	11	208.20	51,812	10,787,306	254.16	58,972	14,988,330
	11.5	208.20	304,747	63,448,377	254.16	170,408	43,310,771
	12	212.74	507,526	107,971,104	259.61	308,755	80,155,943
	12.5	216.54	1,128,614	244,390,093	263.60	1,249,395	329,340,562
	13	220.42	1,678,846	370,051,200	267.83	1,876,456	502,571,195
	13.5	224.88	865,626	194,661,938	271.75	344,748	93,685,280
	14	230.45	77,880	17,947,332	276.87	102,686	28,430,589
	14.5	236.18	334,774	79,066,942	282.19	238,798	67,386,539
	15	242.02	0	0	288.21	0	0
TOTAL			5,220,381	1,144,654,157		4,351,196.75	$1,160,117,957
Base = Final Price 1 CWRS		(a)208.20			(a)$254.16		
Avg. Price $/Tonne				(b)$219.27			(b)$266.62
Increased Revenue $/Tonne				(b-a)$11.07			(b-a)$12.46
No. 2 Canada Western Red Spring	Base	$204.71	188,857	$38,660,916.00	$251.17	0	0
	11.5	204.71	234,477	47,999,768	251.17	158,933	39,919,289
	12	208.77	414,842	86,606,547	254.54	349,359	88,925,724
	12.5	212.21	1,482,994	314,706,160	258.39	1,416,063	365,896,443
	13	216.11	477,482	103,188,568	262.25	1,068,833	280,301,346
	13.5	220.60	1,071,156	236,296,960	266.20	537,521	143,087,958
	14	226.16	257,171	58,161,891	271.25	135,034	36,628,057
	14.5	231.96	231,479	53,693,891	276.49	95,855	26,503,039
	15	237.67	0	0	282.87	0	0
TOTAL			4,358,458	939,314,701		3,761,597	981,261,856
Base = Final Price 2 CWRS		(a)$204.71			(a)$251.17		
Avg. Price $/Tonne				(b)$215.52			(b)$260.86
Increased Revenue $/Tonne				(b-a)$10.81			(b-a)$9.69
No. 3 Canada Western Red Spring	Base	$196.79	3,005,168	$591,386,936	$247.60	2,163,806	$535,758,395
	12	196.79	70,325	13,839,257	247.60	0	0
	12.5	196.79	7,494	1,474,743	254.44	0	0
TOTAL			3,082,987	606,700,936		2,163,806	535,758,395
Base = Final Price 1 CWRS		(a)$196.79			(a)$247.60		
Avg. Price $/Tonne				(b)$196.79			(b)$247.60
Increased Revenue $/Tonne				(b-a$)0.00			(b-a)$0.00

*CGC Primary and Transfer Shipments from Thunder Bay, Churchill and the west coast. **Revenue realized according to scenario 1.

Table A (continued)

		1994/95			1993/94		
		CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**	CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**
No. 1 Canada Western Red Spring	Base	$195.59	0	$0	$164.01	979	$160,516
	11	195.59	200,300	39,176,733	164.01	58,972	9,672,002
	11.5	195.59	719,256	140,679,363	164.01	170,408	27,948,535
	12	195.59	394,492	77,158,742	164.01	308,755	50,638,944
	12.5	195.59	616,701	120,620,598	164.01	1,249,395	204,913,299
	13	204.62	964,138	197,281,921	164.01	1,876,456	307,757,539
	13.5	210.38	73,503	15,463,467	193.98	344,748	66,874,225
	14	220.76	5,580	1,231,791	193.98	102,686	19,918,972
	14.5	235.15	12,971	3,050,136	228.02	238,798	54,450,826
	15	235.15	0	0	228.02	0	0
TOTAL			2,986,942	594,662,751		4,351,197	742,334,858
Base = Final Price 1 CWRS		(a)$195.59			(a)$164.01		
Avg. Price $/Tonne				(b)$199.09			(b)$266.62
Increased Revenue $/Tonne				(b-a)$3.50			(b-a)$12.46
No. 2 Canada Western Red Spring	Base	$189.45	0	$0	$155.46	0	$0
	11.5	189.45	749,467	141,986,569	155.46	158,933	24,707,778
	12	189.45	291,077	55,144,526	155.46	349,359	54,311,279
	12.5	189.45	2,152,793	407,846,670	155.46	1,416,063	220,141,109
	13	189.45	473,640	89,731,054	155.46	1,068,833	166,160,714
	13.5	203.57	819,104	166,745,020	185.94	537,521	99,946,563
	14	203.57	2,128	433,136	n/a	135,034	0
	14.5	203.57	6,782	1,380,581	n/a	95,855	0
	15	203.57	0	0	n/a	0	0
TOTAL			4,494,991	863,267,556		3,761,597	565,267,442
Base = Final Price 2 CWRS		(a)$189.45			(a)$155.46		
Avg. Price $/Tonne				(b)$192.05			(b)$260.86
Increased Revenue $/Tonne				(b-a)$2.60			(b-a)$9.69
No. 3 Canada Western Red Spring	Base	$180.11	5,320,943	$958,355,064	$142.82	2,163,806	$309,034,790
	12	180.11	0	0	n/a	0	0
	12.5	180.11	0	0	n/a	0	0
TOTAL			5,320,943	958,355,064		2,163,806	309,034,790
Base = Final Price 1 CWRS		(a)$180.11			(a)$142.82		
Avg. Price $/Tonne				(b)$180.11			(b)$247.60
Increased Revenue $/Tonne				(b-a)$0.00			(b-a)$0.00

***CGC Primary and Transfer Shipments from Thunder Bay, Churchill and the west coast. **Revenue realized according to scenario 1.**

Table A (continued)

		1992/93		
		CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**
No. 1 Canada Western Red Spring	Base	$156.82	13,677	$2,144,775
	11	$156.82	0	0
	11.5	$156.82	73,232	11,484,218
	12	$156.82	172,609	27,068,488
	12.5	$156.82	1,937,566	303,849,092
	13	$156.82	666,676	104,548,201
	13.5	$166.74	2,131,491	355,404,739
	14	$166.74	19,174	3,197,071
	14.5	$191.36	164,510	31,480,623
	15	$191.36	0	0
TOTAL			5,178,934	839,177,206
Base = Final Price 1 CWRS		(a)$156.82		
Avg. Price $/Tonne				(b)$162.04
Increased Revenue $/Tonne				(b-a)$5.22
No. 2 Canada Western Red Spring	Base	$150.00	0	$0
	11.5	150.00	121,934	18,290,167
	12	150.00	0	0
	12.5	150.00	1,265,410	189,811,493
	13	150.00	256,558	38,483,738
	13.5	$158.14	388,129	61,378,648
	14	$158.14	0	0
	14.5	$158.14	0	0
	15	$158.14	0	0
TOTAL			2,032,031	307,964,046
Base = Final Price 2 CWRS		(a)$150.00		
Avg. Price $/Tonne				(b)$151.55
Increased Revenue $/Tonne				(b-a)$1.55
No. 3 Canada Western Red Spring	Base	$145.19	4,598,439	$667,647,386
	12	$145.19	0	0
	12.5	$145.19	0	0
TOTAL			4,598,439	667,647,386
Base = Final Price 1 CWRS		(a)$145.19		
Avg. Price $/Tonne				(b)$145.19
Increased Revenue $/Tonne				(b-a)$0.00

***CGC Primary and Transfer Shipments from Thunder Bay, Churchill and the west coast. **Revenue realized according to scenario 1.**

Table B

		1996/97			1995/96		
		CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**	CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**
No. 1 Canada Western Amber Durum	Base	$249.91	722,359	$180,524,795	$286.13	368,575	$105,460,356
	12	249.91	0	0		0	0
	12.5	259.76	9,692	2,517,648	311.69	25,480	7,941,992
	13	264.66	0	0	329.82	0	0
	13.5	269.35	0	0	334.32	0	0
	14	274.23	0	0	341.18	0	0
Base = Final Price 1 CWAD		(a)$249.91			(a)$286.13		
Avg. Price $/Tonne				(b)$250.04			(b)$287.78
Increased Revenue $/Tonne				(b-a)$0.13			(b-a)$1.65
No. 2 Canada Western Amber Durum	Base	$241.40	1,173,335	$283,243,087	$277.55	1,337,008	$371,086,670
	12.5	249.85	0	0	302.41	3,651	1,104,064
	13	253.92	0	0	320.94	0	0
	13.5	258.61	0	0	326.59	0	0
	14	263.49	0	0	331.97	0	0
TOTAL			1,173,335	283,243,087		1,340,659	372,190,734
Base = Final Price 2 CWAD		(a)$241.40			(a)$277.55		
Avg. Price $/Tonne				(b)$241.40			(b)$277.62
Increased Revenue $/Tonne				(b-a)$0.00			(b-a)$0.07
No. 3 Canada Western Amber Durum	Base	$231.10	1,067,992	$246,812,866	$265.68	1,101,098	$292,539,588
	13	236.07	0	0	n/a	0	0
TOTAL			1,067,992	246,812,866		1,101,098	$292,539,588
Base = Final Price 3 CWAD		(a)$231.10			(a)$265.68		
Avg. Price $/Tonne				(b)$231.10			(b)$265.68
Increased Revenue $/Tonne				(b-a)$0.00			(b-a)$0.00
No. 4 Canada Western Amber Durum		$204.74	156,396	$32,020,563	$238.02	137,290	$32,677,851
No. 5 Canada Western Amber Durum		$156.99	24,111	$3,785,225	$219.82	31,446	$6,912,477

*CGC Primary and Transfer Shipments from Thunder Bay, Churchill and the west coast. **Revenue realized according to scenario 1.

Table B (continued)

		1994/95			1993/94		
		CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**	CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**
No. 1 Canada Western Amber Durum	Base	$271.01	827,396	$224,232,689	$235.36	209,320	$49,265,606
	12	271.01	320	86,688		0	0
	12.5	271.01	21,827	5,915,262	n/a	0	0
	13	297.51	0	0	252.41	25,447	6,423,145
	13.5	n/a	0	0	n/a	0	0
	14	n/a	0	0	n/a	0	0
TOTAL			849,543	230,234,639		234,767	55,688,751
Base = Final Price 1 CWAD		(a)$271.01			(a)$235.36		
Avg. Price $/Tonne				(b)$271.01			(b)$237.21
Increased Revenue $/Tonne				(b-a)$0.00			(b-a)$1.85
No. 2 Canada Western Amber Durum	Base	$261.55	1,453,553	$380,176,790	$226.88	555,447	$126,019,803
	12.5	n/a	0	0	n/a	0	0
	13	286.5	0	0	245.18	20,192	4,950,635
	13.5	n/a	0	0	n/a	0	0
	14	n/a	0	0	n/a	0	0
TOTAL			1,453,553	380,176,790		575,639	130,970,438
Base = Final Price 2 CWAD		(a)$261.55			(a)$226.88		
Avg. Price $/Tonne				(b)$261.55			(b)$227.52
Increased Revenue $/Tonne				(b-a)$0.00			(b-a)$0.64
No. 3 Canada Western Amber Durum	Base	$243.30	1,555,933	$378,558,548	$204.33	1,560,605	$318,878,331
	13	n/a	0	0	n/a	0	0
TOTAL			1,555,933	378,558,548		1,560,605	318,878,331
Base = Final Price 3 CWAD		(a)$243.30			(a)$204.33		
Avg. Price $/Tonne				(b)$243.30			(b)$204.33
Increased Revenue $/Tonne				(b-a)$0.00			(b-a)$0.00
No. 4 Canada Western Amber Durum		$209.59	202,193	$42,377,685	$170.42	179,291	$30,554,773
No. 5 Canada Western Amber Durum		$158.11	58,727	$9,285,263	$120.20	82,316	$9,894,427

*CGC Primary and Transfer Shipments from Thunder Bay, Churchill and the west coast. **Revenue realized according to scenario 1.

Table B (continued)

		1992/93		
		CWB Final Prices $/Tonne	CGC Shipments*	Revenue 1**
No. 1 Canada Western Amber Durum	Base	$158.36	942,353	$149,230,959
	12		0	0
	12.5		0	0
	13		0	0
	13.5		0	0
	14		0	0
TOTAL			942,353	149,230,959
Base = Final Price 2 CWRS		(a)$158.36		
Avg. Price $/Tonne				
Increased Revenue $/Tonne				(b-a)$0.00
No. 2 Canada Western Amber Durum	Base	$153.61	647,100	$99,401,049
	12.5		0	0
	13		0	0
	13.5		0	0
	14		0	0
TOTAL			647,100	99,401,049
Base = Final Price 2 CWRS		(a)$153.61		
Avg. Price $/Tonne				(b)$153.61
Increased Revenue $/Tonne				(b-a)$0.00
No. 3 Canada Western Amber Durum	Base	$147.85	468,235	$69,228,540
	13		0	0
TOTAL			468,235	69,228,540
Base = Final Price 2 CWRS		(a)$147.85		
Avg. Price $/Tonne				(b)$147.85
Increased Revenue $/Tonne				(b-a)$0.00
No. 4 Canada Western Amber Durum		$126.16	153,833	$19,407,613
No. 5 Canada Western Amber Durum		$112.34	8,000	$898,707

*CGC Primary and Transfer Shipments from Thunder Bay, Churchill and the west coast. **Revenue realized according to scenario 1.