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A review of inputs determining the Fonterra Base Milk Price

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PARSONS BRINCKERHOFF

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Contents

Abbreviations

AMF	Anhydrous Milk-Fat
APC	Advanced Process Control
BCP	Base Commodity Price
BMP	Butter Milk Powder
DIRA	Dairy Industry Restructuring Act (2001)
EPC	Engineer, Procure, Construct
FEED	Front End Engineering Design
FES	Fonterra Engineering Standards
FGMP	Farm Gate Milk Price
GDT	Global Dairy Trade
MP Model	Milk Price Model
MP Manual	Milk Price Manual
MPG	Milk Price Group
MT	Metric Tonnes
MLD	Million Litres per Day
NMPB	Notional Milk Price Business
OEM	Original Equipment Manufacturer
QC1	Highest product grade possible
R&M	Repairs and Maintenance
RCP	Reference Commodity Products
RFI	Request for Information
RFQ	Request for Quotation
SMP	Skim Milk Powder
WMP	Whole Milk Powder

Executive summary

Fonterra's methodology for setting its Farm Gate Milk Price (FGMP) is guided by a set of principles set out in Fonterra's constitution and prescribed in the Milk Price Manual (MP Manual). These principles govern the detailed rules that underpin the definition of the notional farm gate milk price commodity business (Notional Processor) and the calculation of the FGMP through the use of the Milk Price Model (MP Model).

This Parsons Brinckerhoff report presents findings on whether selected assumptions included in the MP Model reflect notional or current milk season actual costs, and whether these assumptions are practically feasible for an efficient processor (including Fonterra itself) thereby providing for contestability in the market for the purchase of milk from farmers. Table 1.1 provides a summary of outcomes for each key MP Model input in this review.

Table 1.1 Summary review of Milk Price Model inputs

MP Model input	Input based on notional or actual Fonterra data?	Practically feasible for an efficient processor?	Material issue?	Report section
Number of Standard Plant	Notional	Yes	No	3
Capital costs Standard Plant	Notional	Uncertain	Yes	4
Capital costs site services	Notional	Yes	Yes	4
Capital costs milk collection	Notional	Yes	No	4
Operating costs - energy usage rates	Notional	No	Yes	5
Operating costs - energy cost rates	Notional	Yes	No	5
Operating costs – other including water, CIP, effluent	Notional	Yes	No	5
R&M costs	Notional	Yes	No	6

Currently the Milk Price Model uses a number of different asset registers and estimation bases for the definition of the capital assets of the Notional Processor. The list includes specifications and designs of notional plant, asset registers based on actual Fonterra assets, and asset registers for insurance valuation or internal accounting purposes. These differing approaches result in uncertainty around a complete and accurate asset list for the Notional Processor. When the economic and technical practicality of a complex project is to be established, industry standard practice is to carry out a feasibility study; such a study develops a complete high level design and specification for the project, and specifically aims to ensure it is practically feasible, internally consistent and feasible in the aggregate, and hence to allow both capex and opex estimation and economic evaluation. Such an approach is transparent and auditable, and is the recommended approach for the Notional Processor in the Milk Price Model.



1. Introduction

1.1 Background

The Commerce Commission (the Commission) is required to undertake two statutory reviews of Fonterra's base milk price-setting in each milk season under the 2012 amendments to the Dairy Industry Restructuring Act 2001 (DIRA). The base milk price (BMP) is the price paid by Fonterra to dairy farmers for raw milk. It is also known as the 'farm gate' milk price (FGMP).

Fonterra's methodology for setting its FGMP is guided by a set of principles set out in Fonterra's constitution and prescribed in the Milk Price Manual (MP Manual). These principles govern the detailed rules that underpin the definition of the notional farm gate milk price commodity business (Notional Processor) and the calculation of the FGMP.

The first annual statutory review requires the Commission to report on the extent to which the MP Manual is consistent with the purpose of the milk price monitoring regime. The final report for this first review for 2012/13 is available on the Commerce Commission website[1].

The annual statutory review of the FGMP calculation requires the Commission to report on the extent to which the assumptions adopted and the inputs and process used by Fonterra in calculating the FGMP for the season are consistent with the purpose of s 150A, which reads:

> (1) The purpose of this subpart is to promote the setting of a base milk price that provides an incentive to the new co-op to operate efficiently while providing for contestability in the market for the purchase of milk from farmers.
>
> (2) For the purposes of this subpart, the setting of a base milk price provides for contestability in the market for the purchase of milk from farmers if any notional costs, revenues, or other assumptions taken into account in calculating the base milk price are practically feasible for an efficient processor.

This Parsons Brinckerhoff report presents findings on whether selected assumptions adopted by Fonterra reflect notional or current milk season actual costs, and whether these assumptions are practically feasible for an efficient processor (including Fonterra itself) thereby providing for contestability in the market for the purchase of milk from farmers.

[1] http://www.comcom.govt.nz/statutory-review-of-milk-price-manual/.

1.2 Scope and limitations

Parsons Brinckerhoff has provided a review of selected inputs and assumptions contained in the Fonterra Milk Price Model (MP Model) and supporting documentation in relation to:

- Standard Plant, specifically:
  - Identify the engineering specifications of the standard plants assumed in the model.
  - Identify the process flow and plant components requiring capital costing and operational costing.
  - In liaison with a yields consultant, review the capability of the notional plants to manufacture to the assumed yields.
  - Review the peak capacity assumptions.
  - Identify the make-up of notional sites in the model and review their appropriateness to deliver the notional commodity production plan.
  - Identify milk component diversions required to meet the production plan and review treatment in the model.
  - Review whether the model site makeup allows for application of product supply chain costs as identified in the model.
- Capital costing of Standard Plant, specifically:
  - Review the existing capital costing calculations.
  - Review practicality of assumed power function scaling.
  - Identify that the model implements the correct detail for the standard plants, in terms of:
    - Appropriate and consistent capital components included
    - Appropriate installed and replacement costs used
    - Appropriate asset economic lives assigned.
    - Appropriate profile of plant installations and costs over time.
    - Internal consistency of the installed capital calculations in the model.
  - Identify site services costs in the models and review if these are calculated in a consistent way by leveraging Fonterra site actuals.
  - Review the model's treatment of fixed assets required to collect the milk supplied to the Notional Processor.
- Operations costing of standard plants, specifically:
  - Identify that the model provides a consistent picture of operating costs, identifying and reviewing the appropriateness of variable costs, such as for energy, consumables, CIP and effluents, with usage rates assessed as consistent with manufacturer specifications or other benchmarks where manufacturer specifications are not available and cost rates identified and made available for review by Commission analysts.
- R&M and capital asset assurance costs, specifically:
  - Identify the R&M cost assumptions and treatment and verify that these are applied in an internally consistent way.
  - Review the appropriateness of the R&M costs assigned by reference to Fonterra actuals and scaling assumptions applied to convert from Fonterra actual plant.
  - Identify asset capital expenses assumed in the model.

- Review if there is any overlap between R&M and capital treatment of maintenance.
- Review R&M and "Birthday Capital" expenditures in the light of industry best practice and consider whether the most appropriate economic balance is achieved between R&M and capital expenditure.
- Review the tilted annuity calculations in the model to ensure they properly reflect the asset life and replacement cost assumptions.

1.3 Methodology

This review has involved:

- Interrogation of the Fonterra MP Model and supporting documentation.
- Identification of engineering specifications, process flow and plant components.
- Review of appropriateness of input assumptions and cost calculations provided by Fonterra.
- Review of the implementation of standard plant details in the model.
- Review of costs and assumptions against Fonterra site actuals and benchmark data where available and appropriate.
- Liaison with Fonterra (including a site visit to a representative Fonterra plant).
- Liaison with the Commerce Commission Yields Consultant and other specialists.

1.3.1 Review basis

This report supports the Commission's Statutory requirement to review the inputs, assumptions and processes used by Fonterra in the MP Model.

1.3.1.1 Efficiency dimension

The MP Model inputs should reflect that Fonterra (and the Notional Processor) is appropriately encouraged to improve productive efficiency. This implies that there are sufficient incentives for Fonterra (and the Notional Processor) to manage costs and operate efficiently. This test has been applied through the identification of whether an input or assumption is based on actual data or notional data.

1.3.1.2 Contestability dimension

In assessing whether MP Model assumptions are practically feasible for an efficient processor a key consideration is whether model inputs are:

- Whether the assumption is practically feasible for Fonterra
- Whether an assumption is consistent with other inputs or assumptions used in the MP Model
- Whether an assumption is reasonable for another efficient processor.
- Whether there is reason to believe that the notional data is, or is not materially different or achievable in a realistic operational setting.

1.3.1.3 Collective power

The FGMP should reflect the benefits that arise from the collective selling power, scale and other economies Fonterra enjoys. Parsons Brinckerhoff has assumed this includes the collective buying power enjoyed by a company with the scale of the Notional Processor.

1.3.2 Materiality

Parsons Brinckerhoff has focused its review within the scope of the MP Model input assumptions which could have the most material impact on the resultant FGMP. The materiality threshold used in this review is $0.02 per kgMS. Where the exact impact on the FGMP is unknown, the significance of any finding has been assessed by the current contribution of the MP Model input to the overall FGMP calculation.

1.3.3 Assumption uncertainty

Parsons Brinckerhoff has identified the source of input data and assumptions used in the MP Model in order to ascertain the level of accuracy, uncertainty, error or risk around values adopted. Specifically, PB has identified whether costs are based on 'actual' or 'notional' data. The main sources of assumption data included in the MP Model within the scope of this review are:

- Actual data from existing Fonterra plant
- OEM technical specifications
- Independent engineering / specialist consultant review

Benchmark data external to Fonterra's operation has been used to validate MP Model assumptions where available. However, there is a lack of publicly available benchmarks for plant which are similar in scale, configuration and operation given the commercial sensitivity of this type of data.

1.4 Exclusions

1.4.1 Treatment of lactose purchase basis

Lactose is added to raw whole milk or skim milk, to create RCP's with standardised component (fat, protein) levels. The assumption that the Notional Processor has to process the input quantity of raw milk into the RCP's, leads to the requirement for the Notional Processor to acquire a large quantity of Lactose.

The RCP's selected for the MP Model, do not generate by-product streams from which lactose can be separated, and hence the Notional Processor is assumed to need to purchase dried lactose on the global market, reconstitute and use it in the Notional Processor's standardisation processes.

The selection of RCP's that do not generate lactose permeate and hence require import, introduces major and quite fundamental assumptions, that are outside the scope of this review.

1.4.2 Increase in Standard Plant capacity

Fonterra has proposed to increase the peak capacity of the WMP plant to 15.4tph dryer (approximately equivalent to an increase from 1.9 ML/d to 2.4 ML/d) and SMP plant to 10tph dryer for incremental and replacement capex. A review of the assumption changes and model updates resulting from this change will be completed once the revised MP Model is available.

2. Information used to support the review

2.1 Information supplied

Parsons Brinckerhoff has had access to:

- Fonterra information provided to the Commerce Commission and loaded onto the Commerce Commission extranet.
- Some documents supplied via email directly to Parsons Brinckerhoff.
- Hardcopy document supplied by the Commerce Commission.
- Information supplied from Fonterra in response to our Request for Information (RFI).
- Observations and information supplied in the course of a visit to Fonterra's Darfield site.

References to sources of specific information are cited in this report where relevant.

2.2 Information specifically requested

2.2.1 Request for Information

In addition to the information supplied in hard copy, and made available for review via the Commerce Commission extranet, Parsons Brinckerhoff has requested specific information from Fonterra, via "Requests for Information issued initially on 20 May 2013.

2.2.2 Visit to representative plant

Parsons Brinckerhoff has visited Fonterra's Darfield plant, to clarify issues relating to the completeness and practicality of the Notional Processor. This visit added a great deal of value to the process of confirming the completeness of the Notional Processor in terms of the scope of standard plant.

2.2.3 Clarification meetings

Parsons Brinckerhoff has held clarification meetings with the following persons:

- MPG leader
- Yields consultant
- Independent dairy-process expert

2.3 Information quality

2.3.1 Uncertainty ranges and effect on accuracy

Parsons Brinckerhoff observes that there is a great deal of variability in detail.

- In some cases, very finely-grained and detailed real/historical data is used, e.g. milk collection cost asset register
- In other cases, a single figure is used to summarise modelled performance at a much higher level.
- In some cases data is adjusted (capex data updated, and scale-adjusted) either by industry-accepted values or Fonterra actual site values, but inherently approximate approaches.

It would be possible for Fonterra to trace the uncertainty margins for each data item contributing to the final FGMP; a review of this would allow future reviews to concentrate on the data that contributes the greatest level of uncertainty. Parsons Brinckerhoff has identified in the relevant report section where estimation uncertainty is considered material to capital and operating cost model inputs.

2.3.2 Traceability and auditability

For models such as the MP Model, Parsons Brinckerhoff considers that it should be possible to identify unambiguously from within the model, the specific document that has sourced each contributory figure, and the associated derivation approach. This is often termed an 'assumptions book'. This requires a significant effort, and a rigorous approach both to internal citation, document identification and version control.

Without such rigour, auditability is reduced, and there is real potential for decreased accuracy. Following our review of the capital and operating costs in the current MP Model;

- Document identification varies - each should have a title, date, version control information and authorisation.
- Quality of internal citations varies. Without internal citation and associated document identification, it is inherently not possible to be assured that contributory data is current, since there is no way to exclude the possibility that a more recent version of a document exists.

2.3.3 Consistency of independent review

Independent reviews of aspects of the MP Model are routinely carried out, however PB notes that it is unclear from the documentation supplied, that the same Terms of Reference (ToR) have been used to review all aspects of the MP Model components. For example, while the ToR for review of GEA data on core WMP plant is provided, the same ToR is not used to review capex for AMF plant. A consistent ToR would provide additional assurance around internal consistency and feasibility in the aggregate.

3. Standard plant for the Notional Processor

3.1 Identification and characterisation of key plant

This report section considers the Standard Plant (manufacturing) for the Notional Processor proposed in the MP Model.

The Notional Processor assumes the use of a significant number of installations, each of which is assumed to be geographically isolated from the other installation, and each of which contains at least a WMP or a SMP plant rated for the agreed peak milk supply load.

The Notional Processor is absolutely required to be practically feasible as a whole and to demonstrate that its configuration, as a complete competitor, process the raw milk supplied into the RCP's.

This report section considers whether the Notional Processor model has correctly and completely scoped the standard plant required, whether appropriate technology has been specified, and that adequate effort has been made to ensure that a practically feasible and efficient Notional Processor is identified.

3.1.1 Notional plant design capacity

Fonterra has arrived at the notional plant raw milk input design capacity (peak rating) by taking a simple average of the peak milk capacities of all of Fonterra's WMP or SMP driers. While numerically correct this data includes some very small plant (which would never be considered by an efficient processor) however this approach is allowed by the safe harbour assumption.

Fonterra then arrive at a number of plants (as a base number not including future plant requirements), based on the selected milk input divided by the average peak capacity of all of their plants.

Table 3.1 Number of Standard Plant

Standard plant type	Number (excluding incremental)	Plant capacity
WMP	24	13 MT/h
SMP	18	9 MT/h
BMP	4	4.5 MT/h
Butter	6	10 MT/h
AMF	3	10 MT/h

Parsons Brinckerhoff understands that there is a proposal to increase the peak milk daily intake to the standard WMP and SMP plant for incremental and replacement capex, in future. Parsons Brinckerhoff notes that an increase in peak milk intake may result in changes to the numbers of plants considered in the Notional Processor, the inter-site transport issues, and in the scaling applied to capex data.

3.1.2 Notional Processor plant definition

Parsons Brinckerhoff would have expected to see a "feasibility study", describing the Notional Processor, specifically including a register of plant items, design specifications and scope proposed for each notional site.

A feasibility study approach would provide transparency, and would facilitate checking that the Notional Processor meets the MP Model test of practical feasibility on individual plant basis and in the aggregate.

Without such a feasibility study, we consider that the estimation of site services capital costs may not have captured the economies of scale that are available on a site which hosts several processing plants, and we suggest that further investigation is needed to confirm whether this matter reaches the materiality limit of the Commission's review. The sites services replacement cost (including site infrastructure) totals $1,590 million (in 2008 $) comprising approximately 26.3% of the total replacement cost of manufacturing plant for the Notional Processor.

3.2 Information used to review standard plant

In conducting our review, PB has referred to the following key information:

- The 2008 specification supplied to GEA by MPG, and GEA's plant proposal prepared in response to these two specifications (WMP and SMP).
- The DTZ asset valuations May 2008 spreadsheet.
- Information listed in the Capital Costs category of Attachment 3 in the Fonterra 'Reasons' paper[2].

3.3 Basis for assessment of standard plant

Parsons Brinckerhoff has used the following basis for assessing the standard plant proposed:

- **Scope.** Have all major components/systems for the notional plant been identified – and included in the model (i.e. the ability to confirm that there are neither exclusions, nor duplication). This assumes a clear statement of the boundary limits for the plant to be considered.
- **Technology.** Whether the technology proposed for the major plant components/systems, is the most appropriate type for the end use.
- **Scale.** Have all major plant components/systems been reasonably sized for the notional plants.

These questions are answered both in Sections 3 and Section 4 of this report.

3.4 Assessment of Standard Plant

3.4.1 Milk collection

The scope of milk collection assets includes all plant required from on farm capital assets (primarily vats) through pickup from the farm milk vat outlet, to the raw milk intake at the notional manufacturing plant. For the tanker capabilities diesel B-Train or equivalent tankers are assumed. These are standard assets and no differences between Fonterra and Notional Processor practices are likely.

[2] 'Reasons' Paper in support of Fonterra's base milk price for the 2012/13 Season. 1 July 2013.

Road transport tanker sizing is determined by NZTA rulings; there is no reason to doubt the approach used in the MP Model. (MP Model treatment of Milk Collection asset costs are discussed further in Section 4.3).

3.4.2 Transport of lactose and intermediate products

Transport of consumables such as coal and CIP chemicals are included in the purchase prices, and so need no additional treatment in the MP Model.

The transport of lactose from port to plant and the transport of intermediate products (e.g. pasteurised cream) between plants are functions that are implicit in the operation of a Notional Processor, and hence are included within the MP Model.

These capabilities can be assumed to use tankers of similar technology/scale as those used for milk collection.

The review of these transport operations is not included in the scope of this review.

3.4.3 Milk reception

The Notional Processor milk reception facilities must include all plant from tanker discharge to raw milk silo discharge terminal point; hence tanker bays and tanker wash (tanker CIP), raw milk silos and raw milk silo CIP facilities.

Milk reception facilities are currently excluded from the scope of plant specified to GEA in 2008.

The Notional Processor's waste treatment plant (considered elsewhere) needs to be at a scale that can cope with tanker wash and CIP requirements of the milk and lactose reception facilities.

The technology required for milk reception plant, on the scale envisaged, is well-established. While no specification has been provided for the technology anticipated for the Notional Processor, PB does not expect this to be contentious.

At the least, the Notional Processor needs to include:

- Tanker bays (minimum 2 for raw milk).
- Tanker pumpout.
- Raw milk storage
- Tanker bay and raw milk silo CIP.

The description of the priced offer from GEA shows optional approaches for lactose reception (tanker input of permeate, and reconstitution of powder). It is unclear which is included in the capex estimate. Since the Notional Processor is assumed to import lactose, there would not seem to be any value in including permeated tanker intake; the model would better reflect reality if it assumed delivery of lactose powder in bulk bags, and included facilities for lactose reconstitution (using either water or milk).

For notional sites that do not include provisions for processing all RCP's, a minimum of one tanker bay for loading in/out is required, with associated storage and CIP capabilities.

3.4.4 Major WMP milk processing plant

The required scope includes all plant from the outlet of the raw milk silos and the lactose reception system. This therefore includes:

- Separators

- Standardisation process including mixers and buffer tanks for skim and lactose solution and for standardised raw milk.
- Filtration
- Chilled raw cream silo, cream pasteuriser, cream storage tanks and road-tanker discharge facilities.
- Pasteurisation. There are significant differences in possible approaches to pasteurisation. For the purposes of constructing a nominal competitor, we believe that the approach used by Fonterra is now considered standard and hence is appropriate for the model.
- Evaporators. The configuration commonly found in similar-sized Fonterra plant includes three evaporators each with 1-effect MVR and 2-effect TVR, and is considered good practice.
- Concentrate tanks, concentrate heaters.
- Either homogeniser plant (as shown in GEA proposal, for use with disk atomisation) or HP pumps (for nozzle atomisation-type of dryer) – these are expected to be very similar capex
- A single MSD (IFB-type) spray drier with atomization,
- provision for lecithin application
- Intake air filter, airheater(s) and fans required for the drier. Steam-air heating is considered good practice, although gas-fired airheating is equally feasible.
- External vibrating fluid bed fan air supply and ductwork to baghouse.
- Cooler/sifting.
- Baghouse filters and fines return for drier.
- Bulk powder bins and sifting/sizing plant.
- Gas flushed bagging is required. Either 25kg bags and palletising, or bulk bags would represent a reasonable competitor approach.
- CIP plant to service all of the above
- Control and instrumentation to operate plant, including startup, QC, CIP, changeovers and shutdown.

Specifications for the SMP and WMP plants are contained in two Connell Wagner specifications, attached to message “Information on standard plants”, dated 5 Apr 2012. These specifications cover the key product-specific plant (the “core” plant) of the Notional Processor, as regards SMP and WMP. Some uncertainties still exist in regard to the scope of the GEA submission.

Provisions for powdered lactose reconstitution must be included, and similarly Lactose permeate reception and permeate silos should not be included as the MP Model assumes import of lactose.

The standardisation, evaporation, concentrate handling, homogenisation, drying and powder handling technologies proposed for the Notional Processor are considered appropriate technology for the Notional Processor. This configuration is considered to be standard, and allows the reasonable operation/CIP cycle times to be harmonised.

Cleaning In Place (CIP) plant to service the components within GEA’s scope is included in GEA’s proposal.

It appears that provision has been made for the plant defined above in the MP model, however it is unclear that the capacity of the plant proposed has been linked to the plant configurations proposed for each of the Notional Processor sites, and hence it is not clear that possible economies of scale have been captured.

3.4.5 Major SMP processing plant

Scope should include plant from the outlet of the raw milk silos and the lactose reception system. This therefore includes:

- Separators (SMP plants). In contrast to the WMP plant, these will be sized for the full peak capacity of the SMP plant.
- Standardisation process mixers and buffer tanks for lactose solution and standardised skim milk.
- Chilled raw cream silo, cream pasteuriser, cream storage tanks and road-tanker discharge facilities.
- Pasteurisation. There are significant differences in possible approaches to pasteurisation. For the purposes of constructing a nominal competitor, we believe that the approach used by Fonterra is now considered standard and hence is appropriate for the model.
- Evaporators. An MVR effect and two TVR effects, is considered good practice). For plant of the nominal peak milk input rate, three evaporators and one dryer are considered a practical approach.
- Concentrate tanks, concentrate heaters.
- A single MSD (IFB-type) spray drier with atomisation.
- Intake air filter, airheater(s) and fans. Steam-air heating is considered good practice although gas fired heaters are also acceptable.
- External vibrating fluid bed fan air supply and ductwork to baghouse.
- Cooler/sifting.
- Baghouse filter and fines return.
- Gas flushed bagging is required. Either 25kg bags and palletising, or bulk bags would represent a reasonable competitor approach.
- CIP plant to service all of the above.
- Control and instrumentation to operate plant, including startup, QC, CIP, changeovers and shutdown.

Specifications for the SMP and WMP plants are contained in two Connell Wagner specifications. These specifications cover the key product-specific plant (the “core” plant) of the Notional Processor, as regards SMP and WMP.

Provisions for lactose reception/processing – see comments re WMP.

There are some points on which the scope of the OEM quotation is unclear: these need clarification.

The standardisation, evaporation, concentrate handling, drying and powder handling technologies proposed for the Notional Processor are considered appropriate technology for the Notional Processor. This configuration is considered to be standard, and allows the reasonable operation/CIP cycle times to be harmonised.

Cleaning In Place (CIP) plant to service the components within GEA’s scope is included in GEA’s 2008 proposal.

Control and monitoring is a major component of milk processing plants; Fonterra has noted that their APC-type control system has not been included, but that a basic control system is included. Fonterra will have installed their APC system for sound economic reasons, and on that basis an efficient competitor could be expected to come to the same conclusions. This issue is explored further in Section 3.4.8.

3.4.6 AMF processing plant

The GEA proposal does not include any AMF/butter making or handling plant. AMF processing plant should include cream reception, main cream storage tanks, main cream separator, buttermilk separator and fat return, and AMF storage, AMF drum filling and sealing, and warehousing.

The scope of the AMF plant proposed in the model is derived from a 2008 DTZ assessment, a replacement cost valuation of the Edendale AMF plant. The list of plant components included in the valuation is considered practically feasible.

3.4.7 BMP processing plant

The 2008 GEA proposal does not specifically provide capex estimates for BMP manufacture plant: For the purposes of capital cost assessment, evaporation and spray drying plant that is technically similar to that proposed for SMP would seem adequate (there are differences, but they are not likely to reach materiality).

Storage and transport of butter milk (prior to evaporation and drying to BMP) is required for the practical operation of the Notional Processor, and must be accounted for in the model.

Although the upper limit on BMP production is set by mass balance considerations, the option of adding BMP to a SMP input stream effectively removes a lower bound to BMP production.

Proposed BMP production has been determined for the Notional Processor by economic optimisation approaches.

The number of BMP plants proposed for the Notional Processor is feasible, however an optimisation of this number would require consideration of technical capacity limits, utilisation and transport costs, and is outside the scope of this report.

The scope of the BMP plant proposed in the model is derived from a 2008 DTZ assessment, a replacement cost valuation of the Te Awamutu BMP plant. The list of plant components included in the valuation is considered practically feasible.

3.4.8 Plant control

Control and monitoring is a major component of milk processing plants; Fonterra have noted that their APC-type control system has not been included in the Fonterra specification issued to GEA, but that a basic control system is proposed for the Notional Processor. In addition to the basic control system allowed for in the Standard Plant replacement costs, the Capital Cost model includes an allowance of [ ]% of the total gross replacement costs ([ ]) allocated to the 15 year economic life category.

The sales value of the Fonterra products is based on a proposed level of QC1 product (the total proportion of QC1, and the length of time required for new plant to consistently achieve QC1), which is made technically possible by the use of advanced control systems designed precisely to maximise the proportion of QC1 product.

The technical proposal for the Notional Processor does not currently include significant provisions for rework of downgraded product: This assumption may be defended if the process control system ensures low rates of rework – but conversely, if a control system requiring lower capex is proposed, then additional capital cost provision for product rework would be justified.

If a control system requiring less capex is installed, then the sales values should reflect what is possible with that control system. Fonterra will have installed their APC system for sound economic reasons, and on that basis an efficient Notional Processor could be expected to come to the same conclusions. Parsons

Brinckerhoff finds that the allowance for the control system is practically feasible (individually), however it is not clear whether this level of cost is internally consistent with other MP Model assumptions.

If the yields inputs and lactose requirements included in the MP Model are assumed to be practically feasible, then the level of control system capex will need to be consistent with those assumptions. Parsons Brinckerhoff has not reviewed any technical data from Fonterra or detailed support for the additional [ ] allowance to confirm the consistency of control system capex with other MP Model assumptions.

3.4.9 Waste processing plant

A complete Notional Processor needs, for each site, a waste processing plant that must include capability to process:

- All CIP waste.
- Neutralisation waste arising from water treatment systems.
- Reject product and losses (rated for significantly more than the guarantee loss rates in the product schedules).
- Boiler blowdown.
- Site sewage.

The Waste processing plant should also include emergency bunded storage and pump-out capabilities, to control unforseen events. This is a prudent technical measure for a process plant in which accidental spillage would have environmental implications.

Reasonable equipment for waste processing plant would include.

- Storage silo for untreated CIP and related liquid
- DAF or similar BOD/COD control plant
- Treated water silo
- DAF sludge storage and truck-out
- Neutralisation tank for blowdown and regen waste, with tanker filling provisions.
- Either local sewage treatment, or cost allowance for connection to municipal plant

While allowance has been made for waste treatment, the scope that has been included in the MP Model requires clarification, specifically to ensure that the plant proposed is appropriate in type and scale for each of the Notional Processor sites.

3.4.10 Energy supply plant

Scope: A complete Notional Processor needs, for each site, an energy supply. The energy supply system would need to be aligned to the plant installed, and would need to assume either coal supply via road transport or HP gas supply to site boundary.

It is assumed that no coal processing (drying sizing, or other) is required on site.

It is assumed that product contact steam may be required, and hence appropriate water treatment is required.

Boiler plant should therefore include:

- Ground level grizzly (tip-in grill for coal) and underground coal reception hopper [coal].
- Gas reception station [gas].

- En-mass or similar conveyor) [coal].
- At least two storage hoppers able to hold 3 days-worth of coal) [coal].
- At least two boilers, each rated for 60% of the peak steam usage rate, with fans.
- Baghouse filters and ash handling plant [coal]. It is assumed that no flue gas treatment is required, and that continuous emission monitoring is not required.
- Boiler Management System (BMS) and all C&I and monitoring systems.
- Common stack.
- Water Treatment Plant (suitable for permitted treatments for food processing plant).
- Feedheating and feedwater control, common deaerator.
- Three * 50% rated Boiler Feed Pumps.
- Fire protection system.

In addition to the boiler system, a practical Notional Processor will require

- Hot water systems – commonly these are direct steam injection systems.
- Spray drier airheater.

The scope and specifications of this class of plant, proposed for the Notional Processor, are unclear, and it is not possible to evaluation adequacy

We note that it is quite possible to specify only a single boiler, and reduce capital cost. This is not considered good practice.

Boiler plant sizing needs to take account of security/redundancy, hence requirement for two boilers rated for 60% of peak steam demand. These boilers will operate for much of their life at low load, and boiler plant needs to be capable of operating for significant periods at low load; this is an essential requirement for a practical Notional Processor. It is unclear what scope has been included in the model.

While it is understood that the purpose of the model is to derive a FGMP, the validity of the cost does rely upon an assumption that adequate plant has been considered in the price development.

The boiler sizing and configuration proposed in the model is unclear, and appears to be derived by scaling and adjustment process from an actual Fonterra installation. It appears that all essential items of equipment are identified for inclusion in the MP Model, however the MP Model needs to clarify the basis on which costs are allocated to Notional Processor sites, to ensure that ratings are appropriate and that economies of scale are obtained.

3.4.11 Maintenance, testing, operational and administrative facilities

Each notional plant site requires:

- Administrative facilities.
- Laboratory facilities.
- Control rooms.
- Maintenance facilities.

The scope and specifications of the plant proposed for the Notional Processor, are not clearly linked to the Notional Processor sites, however important line items for inclusion in the Notional Processor inventory, have been identified.

3.4.12 Other service plant

A complete and functional Notional Processor could also be expected to require the following additional service capabilities at each site:

- Compressed air and instrument air systems.
- Chilled water system, cold water system.
- Potable water system.
- Sewage system.
- Telecoms and data network.
- Site control, monitoring logging and archiving system – this is in addition to the local control systems for major plant items.
- Fire protection system and fire water storage.
- Gas supplies – flushing and packing. CO_2 and N_2 for product packing are essential for the Notional Processor. CO_2 would be commonly supplied via bulk tanker and require a local storage vessel. For plant of the peak capacity envisaged for the Notional Processor, an air separation plant to supply N_2, would be considered reasonable practice, though bulk supply is not likely to be much more expensive.
- Consumables store (packaging, etc.)
- The scope and specifications of the service plant proposed for the Notional Processor, are not clearly linked to the Notional Processor sites, however important line items for inclusion in the Notional Processor inventory, have been identified.

3.4.13 Product storage and handling (transport)

The Notional Processor should also include, for each site:

- Dry warehousing. Dry storage volume relates to the opportunities for sales phasing: Dry storage capable of holding from 25% to 75% of annual powder production would be not unreasonable; this represents a covered storage area of between 2Ha to 6Ha total.
- Forklift for loading curtain-wall truck, or container.

The model includes provision for dry storage, which Parsons Brinckerhoff finds practically feasible.

3.4.14 Fonterra reference plant

PB staff visited Fonterra's Darfield plant, to compare the configuration of this (reference) plant with that included in the MP Model.

The only plant currently operating on the Darfield site is a 15tph WMP plant. The second drier (D2, 30tph capacity, plus associated additional site services) is under construction, and the site was designed for this additional plant. Darfield site is within 3-4 hours' drive of the Clandeboye site, and hence the Clandeboye site can offer some backup facilities.

The equipment and configuration on the Darfield site correspond well with the proposed configuration of the core Notional Processor plant, however we note the following:

- The majority of the site configurations for the Notional Processor do not comprise a single WMP plant, and hence the Notional Processor could reasonably be able to achieve economies of scale in respect of site services plant (when compared to Darfield D1).

- As noted elsewhere, there is no need for the Notional Processor to allow for lactose permeate reception.
- The dry storage facility sizing is highly dependent on the anticipated level of sales phasing. The size used for the Notional Processor should not necessarily be based on the Darfield example.
- Similarly, powder rework is needed for the Notional Processor but is not necessarily identical to the Darfield plant.

3.5 Significance of assessment

A key requirement for the Notional Processor is that of completeness and practical feasibility.

The review is required to assess whether the supplied documentation provides direct and clear assurance that all of the equipment required for the Notional Processor to actually function is included (and is not duplicated).

While Parsons Brinckerhoff recognises that this is a difficult exercise, it is a very common exercise for such projects, and we believe that the transparency and therefore ease of auditing the model could be greatly improved.

Parsons Brinckerhoff would prefer to see a “feasibility study”, setting out the Notional Processor as a complete system including plant and service requirements, and then a clear tabulation of plant capacities, and capex estimate bases.

A significant question involves assumptions of spare plant capacity, levels of equipment redundancy, and hence the capability of the Notional Processor to make provisions for a significant outage during a period of high milk availability. The site services footprint was based on Clandeboye infrastructure which includes redundancy for risk mitigation (e.g. multiple boilers) and the MP Model footprint has a nominal plant on-product time allowance of 95% to cater for plant downtime/breakdown to provide a capacity buffer.

No review of the risks and risk mitigation approaches incorporated into the Notional Processor has been carried out, and while it may be assumed that Fonterra’s plant configurations have been selected following a detailed risk assessment, the Notional Processor needs to be designed accordingly, since there is no reason initially to discount risk levels.

4. Capital costs – Standard Plant and collection assets

4.1 Milk Price Model inputs, process and assumptions

An explanation of the calculations included in the MP Model has been provided by Fonterra in the 'Reasons' paper[3]. Table 4.1 summarises the MP Model inputs, process and assumptions for capital costs.

Table 4.1 Capital costs - inputs, process and assumptions

MP Model inputs	MP Model process	MP Model assumptions
Manufacturers' 2008 quotations for construction of WMP & SMP plants. Manufacturers' 2011 quotations for construction of WMP, SMP, BMP, Butter & AMF plants. Detail of actual construction costs for Darfield site. DTZ assessment of: - economic lives & replacement cost valuations of (a) relevant Fonterra assets (comprising butter, AMF & BMP plants, ancillary site services & site infrastructure assets - additional costs relevant to assessment of full replacement costs (consents, capitalised interest etc.) - Jones Lang LaSalle assessment of inflation in replacement costs subsequent to 2008. Book values at 1 August 2012 of Fonterra's milk collection fixed assets.	Determine incremental plant requirements on a forward-looking basis, having regard to forecast changes in milk supply in the North Island & South Island, respectively. Assume full replacement of each major plant component at the end of the component's economic life. 'Spreading back' over time of initial asset base, with effect (for example) that 1/30th of assets with an assumed economic life of 30 years were assumed to have been acquired in each of the previous 30 years.	That approach to determining incremental capacity requirements maintains alignment between milk price asset base & approach to setting relevant cost inputs, including collection costs. That economic life (& implied replacement cost) assumptions are reasonable, including with respect to historic and assumed future rate of technological change. That removal of any provision for 'birthday capex' is consistent with assumed level (& nature) of R&M spend. That there is no material difference between the Fonterra's actual milk collection assets & the assets required by the NMPB.
MWH scaling of DTZ valuations of ancillary assets to requirements of NMPB.		

[3] 'Reasons' Paper in support of Fonterra's base milk price for the 2012/13 Season. 1 July 2013.

4.2 Manufacturing plant capital costs

4.2.1 MP Model calculations

The capital costs for Standard Plant, milk reception and treatment, site services and site infrastructure included in the MP Model have been arrived at in the following way:

- The core components of the standard WMP and SMP plants have been described, with limitations, in a functional specification produced by Fonterra.
- GEA Niro has been supplied with the above specification for the design, supply and installation of a "core" plant for a WMP and SMP factory. GEA have provided a capex estimate for this plant.
- An independent review of input cost data has been carried out, and possible omissions identified in document "MPG File Note: Potential Omissions in Initial WMP and SMP Plant Costings.docx", dated 2 Mar 2010. Identified omissions include civil works, spares, capitalised interest and an independent review of source data has been carried out in the same document, and possible omissions identified in document "MPG File Note: Potential Omissions in Initial WMP and SMP Plant Costings.docx", dated 2 Mar 2010, which included civil works, spares, capitalised interest and Forex. These items are covered by updates to the WMP and SMP costs in the MP Model.
- Some items are noted as optional in the GEA proposal. Inclusion of these items is unclear, and has been commented upon in the technical sections of this report. The capital implications are likely to be below the materiality threshold.
- Capex estimates for AMF, BMP and butter plants have been derived from valuations of existing Fonterra plant. The Fonterra BMP plant technology is based on a modern two dryer powder plant built in 2005/06 except for the TVR evaporators from the old site dating from 1983, however the contribution of this to the FGMP is expected to be small. Comments made elsewhere in this report, regarding assembling site capex values from components, are applicable.
- The capex estimates are used as the replacement costs for each Standard Plant type which are then multiplied by the number of each plant type in the NMPB to arrive at a total replacement cost.
- The capital cost contribution of site services plant, has been derived by a complex process of scaling and adjustment – but importantly, the basic source of the data is the DTZ asset valuations, May 2008. The DTZ asset valuations provide line item estimates of gross current replacement costs, at fine detail, for a small number of actual Fonterra sites (which do not include the Darfield reference site). The line items do appear to cover the major plant items identified as essential in this report.

  The process by which the DTZ line item estimates are scaled and adjusted to generate the MP Model contribution for each of the Fonterra reference plant is complex. The calculation uses site characteristics for a range of Standard Plant types and sizes (e.g. WMP plant 3, 7 10, and 24.5 T/hr) and an associated volume of milk treatment per day (ML/day). The plant characteristics are then combined with the corresponding DTZ valuation line item values, (undefined) factors, a DTZ valuation scaling factor and price indexation to produce the replacement costs.
- Replacement costs for all capital assets are allocated to assessed asset economic life categories, from which depreciation and capital charge annuity costs are calculated.

The ToR proposed to GEA include statements to the effect that plant standards (for the plant within the GEA scope, and with some specific exceptions) are to be similar to those used for ED4. Parsons Brinckerhoff is not aware of any specific concerns regarding this standard.

The MP Model uses a tilted annuity approach for allocating the R&M costs across the profile of standard plant comprising the Notional Processor. This approach calculates an annuity charge that changes over time at the same rate at which the price of the asset is expected to change. This approach is common practice

and a reasonable method of allocation given the price of Notional Processor capital plant is expected to vary over time.

4.2.2 Review of capital cost components

4.2.2.1 Capex of significant plant items, other than WMP/SMP plant

The capex estimates provided by GEA exclude many items. Some items are noted as exclusions-from-scope in the 2008 GEA capex estimate, however Parsons Brinckerhoff notes that many items that are actually needed to assemble a working and complete Notional Processor are not explicitly listed either in the GEA exclusions or elsewhere and that the precise scope of these documents is unclear.

The major production plant items not included in the GEA capex estimates include the Butter, AMF and BMP plants.

The DTZ asset valuations May 2008 provides some Fonterra actual capex and depreciated capex values for various plants, and also contains some values for AMF and for various services.

The specifications for basic WMP and SMP plant, which GEA used for capex estimation, have been generated by Connell Wagner, contracted to Fonterra MPG.

4.2.2.2 Capex implications of significant plant standards

The RFQ issued by the MPG have requested a nominated international standard as the basis of quotation, and have specifically exempted the supplier from “Fonterra Engineering Standards” (FES). Parsons Brinckerhoff understands that the FES requirements are a combination of “General Technical Conditions”, aimed at equipment standardisation across sites, and specific requirements designed to ensure that product quality can be brought to highest grade quickly and maintained there – and to allow significant operational flexibility.

The MP Model also quotes the requirement that the Notional Processor should not be “over optimised”.

Parsons Brinckerhoff considers that an efficient competitor would implement an equivalent of the FES, as a good engineering practice measure (over and above the basic international standards proposed as basis for capex quotation) in the interests of minimising spares holdings and standardising maintenance procedures.

4.2.2.3 Site services

Given the inputs, process and assumptions used for calculating the site services replacement costs for each of the Standard Plant belonging to the Notional Processor are not explained in the MP Model documentation, it has not been possible to determine whether the associated costs are practically feasible.

There appears to be an inconsistency in approaches between calculating the sites services replacement costs for the NMPB and calculating the Standard Plant replacement costs. There is only one size assumed for the WMP Standard Plant replacement cost, however the calculation of sites services replacement costs are based on four different sized WMP plants. While this represents an inconsistency of approach between the different model inputs, correcting this issue in isolation is unlikely to result in a material variation to site services costs.

4.3 Milk collection asset capital costs

4.3.1 MP Model calculations

The capital costs associated with the milk collection fixed assets are a function of:

- Costs provided in a 'desk top' replacement cost valuation of Fonterra's collection assets compiled by Ernst and Young in April 2009. The two most material asset classes being farm vats and vehicles comprising approximately 80% of the total depreciated replacement cost of collection assets.
- Each collection asset category (e.g. vehicles, vats, buildings, etc.) is assigned an economic life by which annual depreciation and capital charge costs are calculated.
- Incremental asset costs are based on Fonterra's approved business plan spend on collection assets.

4.3.2 Review

The collection fixed assets register used to derive the capital cost is accounting based and is considered indicative of Fonterra's actual collection asset base. From Parsons Brinckerhoff's review it is not clear whether any adjustments to the asset base were performed to ensure consistency with the size and structure of the Notional Milk Price Business. This introduces the question of whether the Notional Processor would require the similar size and range of collection assets to support the Notional Milk Price Business.

Parsons Brinckerhoff can see no issue with using an indicative fixed asset register based on Fonterra's actual asset base for the collection assets of the Notional Processor, however an attempt should be made to ensure consistency with size and structure of the Notional Milk Price Business. To produce a more accurate indication of the farm vats included in the asset base, an estimate of size and age profile was prepared by Fonterra and used as an input to the replacement cost valuation. For the tanker fleet the fixed asset register used in the replacement cost valuation had not been updated with the current fleet list and a question arises as to whether the asset base includes associated assets such as pumps, pipes, tanker barrels and metering equipment.

There are obvious difficulties in using Fonterra's actual asset base to reflect the collection assets of the Notional Processor. For example, the location and number of Standard Plant is a different profile to Fonterra's, and hence the vehicle requirements will be different. To ensure that the collection asset base is practically feasible PB would recommend that the scope and size of assets included in the collection asset register is reviewed regularly to ensure consistency with other assumptions and inputs for the Notional Processor.

The scope of on-farm collection fixed assets included in the asset base is unclear. For example, on farm assets could include:

- Vacuum pump (milking machine).
- Air separator.
- Pre-cooler (plate heat exchanger).
- Vat (with agitator, dimple-pad, etc.) and refrigeration unit.
- Hot water tank for CIP.

It has not been possible to determine the extent of the possible mismatch between the fixed asset register used in the replacement cost valuation and a notional fixed asset register which is practically feasible for the Notional Processor, however it is not likely to be material.

It is unclear whether the incremental collection asset costs allowed for in the MP Model (which are based on Fonterra's business plan) are consistent with production growth in the NPMB, however any discrepancy is not likely to be material.

Fonterra's Reasons Paper indicates the milk collection assets are input from the book values of Fonterra's actual collection assets at 1 August 2012. This appears to be inconsistent with the source of replacement cost values used in the Capital Cost model (refer to Section 4.3.1). The impact of this inconsistency will need to be reviewed.

4.4 Review of input basis for capital costs

4.4.1 Capex uncertainty levels

Parsons Brinckerhoff commonly undertakes projects at a variety of stages, from "concept", "feasibility study", through to EPC tendering, and construction/commissioning. Our own experience aligns fairly well with the recommendations of the Association of Cost Engineers (http://www.acoste.org.uk), and the (American) "Association for the Advancement of Cost Engineering International" - AACE (http://www.aacei.org), and has shown that obtaining a "capital cost estimate" is an activity subject to very many possible misunderstandings. The most significant relate to the scope of the work, and the accuracy of the estimate.

We would expect that a "request for cost estimate" on an EPC project, would commonly be treated by a supplier as a request for budgetary estimate, and could be expected to have an accuracy of ±30%. If requested, a supplier might indicate a figure that has +5% & -20% confidence limits – which is clearly significant for this case - but this would be achieved by the supplier moving the estimate to the upper bound of the uncertainty range.

We believe that the Model should clearly identify not only the accuracy limits, but the basis for statement of the accuracy limits of capex.

4.4.2 Capex adjustment for scale

It is very common to scale capex values using a formula of the type:

*Target capex = reference plant capex * ((target plant capacity)/(reference plant capacity)) ^ scale-factor*

For this approach, scale-factor values are commonly taken from the IChemE "Guide to Capital Cost Estimating 4th Edition" (2000) Author(s): Mark Gerrard. (the "Blue Book"), or similar. Although a scale-factor of 0.66 is very commonly used, authors such as Dysert L (2001) ["Sharpen your capital cost estimation skills". Chemical Engineering, Oct 2001 p71] report that these factors can actually vary from 0.45 to 0.8 in practice. Earlier publications by IChemE suggested scale-factors for various equipment types and size ranges. It is also well-known that applying such an approach loses accuracy rapidly where the capacity ratio is large. The use of a scaling factor (exponent) introduces uncertainty into capex estimates.

The scaling factors used in the MP Model are MWH assumptions previously used in the CMP model developed and maintained over the 2002-2008 period. We believe that where scaling factors are used, the basis for selection of the exponent should be justified.

4.4.3 Capex assembly from capex components

Where a total capex figure is built up from many capex components, unless the components are functionally separate, care is required to avoid either duplication or "gaps" in capex. Hence, while it is reasonable to obtain energy plant capex estimates separately from major processing plant capex items, Parsons Brinckerhoff believes that it is undesirable to obtain processing plant capex components separately. We

consider it would be preferable to obtain, from OEM's, itemised costs for the largest composite sites proposed for the Notional Processor (separately for WMP-based and SMP-based site).

4.4.4 Capex updating

Parsons Brinckerhoff notes that the capex estimate is a snapshot in time, however we also note that capex estimates commonly have 30 day validity periods, and (despite the use of escalation provisions based on proportions of values and assignation of international price indices) can vary quite rapidly. We note that the date at which the capex is applied to the MP Model is not within the validity period of the OEM capex estimates.

Although a CPI/CGPI updating approach has inherent uncertainties, PB believes that where capex values more than about 3 months old are to be used, agreed CPI/CGPI bases for updating should be used, and preferably by using multi-component indices linked to prices of major components (e.g. stainless steel).

The current Standard Plant replacement costs were reviewed in 2011, however any update required has not been included in the current F13 MP Model. Parsons Brinckerhoff understands that the MP Model updates resulting from the 2011 manufacturers quotations for construction of WMP, SMP, BMP, Butter and AMF plants will be included in a subsequent version.

Neither the manufacturers' 2011 quotations nor the actual construction costs for the Darfield site have been included in updates to the MP Model version reviewed. This is inconsistent with the capital cost inputs identified in the Fonterra Reasons Paper. The updated costs will only apply to incremental plant and replacement capex which represents approximately 5% of the total F13 capital costs.

4.4.5 Capex basis

For consistency and validity, Parsons Brinckerhoff considers that it is important that capex should be on a greenfield EPC basis. Hence, we would expect the model to assume that bare land is available initially, and that capex estimates assess final, handover costs, including owner's costs (legal, interest during construction, insurance), all transport-to-site, site-work, and the complete design, procure, construct, commission, test, operator-training and handover aspects in the capex estimate. From our review it appears that material items are included, and hence practically feasible, however the description of items is only at a high level.

4.4.6 OEM capability to provide valid capex

Parsons Brinckerhoff has no concerns that GEA are capable of providing a valid capex estimate for the plant type proposed. We note however that:

- OEM has indicated some concern regarding the provision of estimates for plant whose size specification does not correspond to their standard plant size ranges.
- It is common practice to obtain capex estimates from more than one OEM in a real tendering situation.
- The OEM has been given some specific instructions on the basis of the capex estimate required – these are commented upon elsewhere in this report

4.5 Significance of capital cost review

The effect of these conclusions is:

- **Capex scaling for key processing plant**. Significant uncertainty is introduced by the application of scaling factors.

- **Capex contribution of site services plant**. This is ultimately derived from DTZ asset valuations of actual Fonterra plant. The process of scaling and adjusting the DTZ site services valuation data to generate FGMP contribution is complex and appears to be inconsistent with the process for calculating manufacturing plant replacement costs for the NMPB. It is not possible to assess materiality or comment on whether the site services costs are practically feasible.
- **Capex of plant not included in GEA estimate**. The scope of the both the GEA proposal, and the DTZ line items for plant outside the GEA scope, are not precise, however Parsons Brinckerhoff considers that the line items quoted by DTZ, plus the scope of the GEA proposals, are acceptably close to the plant required for the Notional Processor.
- **Capex associated with good plant standards.** Parsons Brinckerhoff considers a large-scale efficient processor would implement a General Technical Standard similar to Fonterra's FES (specifically excluded in the GEA specification).
- **Likely effect of competitive tendering of plant**. It is uncertain whether a competitive tender would indicate a change to the capital cost estimate.

An uncertainty margin of ±5% has been quoted for the GEA Capex estimate. In view of the specification detail provided, Parsons Brinckerhoff considers that the uncertainties are likely to be much larger. For the level of specification provided, Parsons Brinckerhoff would consider it common for OEM's to offer capex estimates on the basis of ±30%.

Parsons Brinckerhoff notes that although Aurecon have provided a detailed report (2011) on capital cost items associated with the Notional Competitor, the capex values (related to core processing plant), in the current model, are derived from the 2007/2008 GEA estimates, as are the capex item scopes.

Parsons Brinckerhoff notes that the capital costs for all non-core plant are actually derived from DTZ asset valuations of line items associated with three specific Fonterra sites. We consider that while significant line items have been identified within this approach, the model should consider the realistic potential for economies of scale that might be reasonably expected on the Notional Processor sites.

Parsons Brinckerhoff considers that the level of detail of the specification of capital plant is of marginally adequate quality. To meet the requirements of this exercise, the complete Notional Processor's plant requirements should be established using a FEED approach, a contracting strategy should be decided, and the costs should for all the plant should be obtained on a similar, adequate, and competitive basis.

For the purposes of modelling, and given the discussed uncertainty, Parsons Brinckerhoff would associate an estimation accuracy range for the plant replacement costs of ±15%. The total replacement cost for the Standard Plant included in the F13 model is $6,122 million (2008 $).

5. Operating costs including energy

5.1 Milk Price Model inputs, process and assumptions

An explanation of the calculations included in the MP Model has been provided by Fonterra in the 'Reasons' paper[4]. Table 5.1 summarises the MP Model inputs, process and assumptions for the selected operating costs.

Table 5.1 Operating costs - inputs, process and assumptions

MP Model inputs	MP Model process	MP Model assumptions
Fonterra's budgeted average unit energy costs for: - electricity - gas - coal - steam Manufacturer's specifications for energy usage per MT of finished product. Fonterra's contracted emission rate. Market price for carbon units.	Using Fonterra's budget energy costs for energy (excluding fixed transmission, R&M, depreciation and ETS costs, but including labour) calculated average $/kwh and $/MT of steam. These rates are applied to the manufacturer's specifications for energy usage per MT of finished product (adjusted for on-site losses) to arrive at a $/MT of energy cost for each RCP, which is applied to production to calculate the cost to the Milk Price business. ETS costs are calculated using the carbon emission amount specified in Fonterra's energy provider's contracts, the amount of energy consumed by the Milk Price business and the average spot price for emission units in the month the energy is consumed.	Fonterra's energy budget is representative of actual costs and usage. That the energy consumption profile between sites within the Fonterra business is materially similar to the Milk Price business. That Fonterra's energy rates are representative of rates that would be paid by an efficient processor.

[4] 'Reasons' Paper in support of Fonterra's base milk price for the 2012/13 Season. 1 July 2013.

MP Model inputs	MP Model process	MP Model assumptions
Fonterra's prior year actual peak energy load by site for gas and electricity and Fonterra's budget costs for electricity and gas transmission. Manufacturer's specifications for peak energy consumption. Peak milk supply for the NMPB.	Peak energy demand for the NMPB is calculated with reference to the manufacturer's specified peak energy requirements and peak milk. Peak energy requirements are applied to Fonterra's budget average peak energy cost rate to arrive at a fixed cost for gas and electricity transmission costs.	Gas and electricity transmission costs are the only material fixed cost in energy provision. That Fonterra's budget peak energy cost rate is representative of actual costs and rates an efficient processor would pay.
The allocated cost per MT for water, cleaning & CIP, consumables, effluent and laboratory testing, sourced from Fonterra's product costing system.	Multiply allocated cost per MT by total MT of each RCP.	That the relevant costs materially vary with production volumes. Fonterra's cost allocation system generates materially supportable cost allocations.

Parsons Brinckerhoff's review has focused on the most material operating cost categories including:

- Energy costs – including the coal, gas and electricity costs and the energy-related costs of operating the Notional Processor's manufacturing plant.
- Costs of services to the plants, including water supply, CIP, water treatment, consumables, laboratory and waste treatment.

5.2 MP Model calculations

5.2.1 Energy costs

The budgeted usage rates for steam and power have been derived from the daily total steam usage and the daily total powder production that are quoted in the GEA capital plant model.

Table 5.2 Energy usage rate assumptions

Energy component	Unit	Butter	AMF	SMP	BMP	WMP
Electricity	kWh/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Steam	StTonnes/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]

Although GEA have modelled the key processing plant, their model is only a subset of the total plant required by the Notional Processor, and the daily production and daily steam usage rates reflect usage at peak production. The Notional Processor would need to assume significant energy (steam and power) usage for plant that is outside the scope quoted by GEA, and would also need to assume an annual average rate that is significantly worse than the rate achieved under plant guarantee conditions (season peak).

A more representative approach to the calculation of energy costs would be based on the annual site usages and annual site production for a complete Fonterra plant that is similar to the Notional Processor.

Based on a RFI response, the annual actual Fonterra plant usage is approximately 10% higher than the value assumed for the Notional Processor which supports the argument that annual totals should be used as the basis of the steam and power usage rates. Parsons Brinckerhoff would expect that energy usage rates need to increase by up to 10% to reflect the practical difference between annual average approaches, and an approach based on extrapolating peak usage rates.

Energy cost rates for power are derived from a weighted average of the actual power prices paid by Fonterra sites which are used to create the budgeted costs. The fuel component of the energy cost rates for steam is derived from a weighted average of the fuel prices (combining gas and coal) for all Fonterra sites.

Table 5.3 Energy cost rate assumptions

Energy cost component	Unit	Butter	AMF	SMP	BMP	WMP
Chilled water	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Compressed air	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Electricity	$/kWh	[ ]	[ ]	[ ]	[ ]	[ ]
Steam	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]

5.2.2 Water, CIP, waste treatment, consumables and lab operating costs

Operating costs are expected to be linearly linked to processing volumes, for a given plant – hence the MP Model uses $/tonne rates extracted from the Fonterra product costing data which uses budgeted costs based on prior years actual data. These $/tonne rates are then applied to the RCP production volumes in the MP Model. The product costing data is an allocation of product costs across key operating cost components based on actual Fonterra data.

Table 5.4 Other operating cost rate assumptions

Operating cost component	Unit	Butter	AMF	SMP	BMP	WMP
Water	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Cleaning & CIP	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Consumables	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Effluent	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]
Laboratory	$/Tonne	[ ]	[ ]	[ ]	[ ]	[ ]

The rates contained in the Fonterra product costing data are matched to the type of Standard Plant and operating cost type defined for the Notional Processor. Rates used in the MP Model have been adjusted upwards allowing for CPI inflation.

5.3 Review of operating costs

5.3.1 Energy costs

Section 1.3 of the Milk Price Manual defines energy costs as:

- *For a Year, the amount Fonterra would incur if the Farm Gate Milk Price Product Mix was produced, given:*
  - *The Resource Usage Rates for each Standard Plant, and*
  - *The Allowable Unit Resource Costs.*

Rule 13 of the Manual defines:

- Resource Usage Rates ('RUR') as resource rates that reasonably reflect optimal achievable usages subject to independent review and verification, and
- Allowable Unit Resource Costs ('AURC') as unit costs that the MPG determines to be appropriate from the following:
  - Contracted rates,
  - Fonterra's actual or budgeted costs, or
  - A provision based on any other method that the Milk Price Group determines will provide a reasonable estimate of the cost that would be incurred by an efficient commodity manufacturer.

The MPG are proposing to split the energy costs into fixed and variable components for the North and South Island plant, and using a weighted average of the production volumes for both islands to arrive at the variable electricity cost for use in the model. The Fonterra analysis indicates this would result in a small reduction (<1 cent) in the Milk Price. Parsons Brinckerhoff finds this approach to more accurately reflect the energy costs of the Notional Processor.

An independent reviewer has previously noted that Fonterra's cogeneration plants will distort both steam and power prices: this is true, but the effect will not be material, as an efficient competitor could reasonably be expected to arrive at similar plant decisions as Fonterra and install cogeneration plants in a similar number of cases.

Having reviewed, Parsons Brinckerhoff considers that the approach to energy cost estimating needs additional work to ensure that the costs derived for the Notional Processor are aligned with the principles of the MP Model. Specifically, PB considers that energy usage should be derived from annual total actual usages (rather than season-peak guarantee design values), to make adequate allowance for the realistic operational pattern and operational security necessities of a Notional Processor. The estimated impact of this adjustment is an increase in energy usage rates of up to 10%.

5.3.2 Review of other operating costs

Generally the inputs, processes and assumptions made for the non-energy operating costs (CIP, waste, consumables, laboratory and water) included in the MP Model are the same. They are calculated from extracts from Fonterra's product costing system, which contains actual prior year cost data for representative Fonterra plant. Given that the rates are what is actually being achieved by plant similar to that assumed for the Notional Processor, Parsons Brinckerhoff considers inputs (product costing data), processes (averaging and allocating across Standard Plant types) and assumptions (plant allocations are representative) are practically feasible.

The MP Model contains only one summary rate for waste, independent of the treatment options. The method of using a summary rate is practically feasible, however we make the following notes regarding the application of this approach to the Notional Processor.

- Environmental pressures will make it increasingly harder for a new market entrant to gain permission to use ocean outfall.
- The capital costs of the land application systems should be included in the capital cost of the processing plant. We did not confirm whether these were included in the MP Model as the associated costs will not be material.

The effect of any changes to cost rates is unlikely to materially affect the FGMP.

CIP, laboratory and consumables costs are expected to be linearly linked to processing volumes, for a given plant. The fixed operating costs (other than capital costs such as plant and buildings, and variable operating costs such as labour) associated with these components are not likely to be material, hence the assumption to use a $/tonne rate is considered reasonable.

Water usage rates per tonne of product are believed to vary over a very large range within Fonterra plants, and hence the MP models use of a broad based averaging approach is a reasonable way to assign values to a Notional Processor and is considered practically feasible.

The product costing system extracts provide a limited data set of information (snapshot of prior year's data for specific Fonterra sites) from which cost rates are calculated. This limitation may not necessarily be representative of assumed operating characteristics of the Notional Processor. Averaging over a longer time frame and across several Fonterra sites that manufacture RCP's (WMP, SMP) may reduce the potential for a single year's data being unrepresentative. However, any variance is unlikely to be material, and as stated above, the inputs, process and assumptions are considered to be practically feasible.

Section 7 of this report summarises the approach used to assess costs of water, CIP, laboratory, consumables and waste treatment.

5.4 Significance of operating cost review

In response to a question, Fonterra has supplied some actual totals of energy used. This information indicates that for representative cases the energy costs in the model are significantly below the total energy costs achieved by representative Fonterra plant over a season. There is no apparent reason why a Notional Processor could operate significantly more efficiently than the representative Fonterra sites, and we have expressed concern elsewhere that the use of energy usage rates reflecting peak-of-season and core plant only will understate realistic value. We recommend that annual total energy consumptions by representative Fonterra plant should be basis for the minimum energy usage rates applied in the model. The estimated impact of this adjustment is an increase in energy usage rates of up to 10%.

The energy cost rates are averaged nationally: If it is assumed that the NI:SI split of Notional Processor production is identical to the NI:SI split of Fonterra production, then the approach currently used is likely to be numerically reasonable. The national average approach does however generate an average of two significantly different figures ($/GJ coal and $/GJ gas). A more transparent approach would be to estimate these values separately, and apply them to the Notional Processor NI:SI production split. This would also facilitate the more accurate assessment of operating costs for incremental plant based on location (NI or SI).

6. Repairs and maintenance

6.1 Milk Price Model inputs, process and assumptions

An explanation of the calculations included in the MP Model has been provided by Fonterra in the 'Reasons' paper[5]. Table 6.1 summarises the MP Model inputs, process and assumptions for the repairs and maintenance costs of the Notional Processor.

Table 6.1 R&M costs - inputs, process and assumptions

MP Model inputs	MP Model process	MP Model assumptions
Fonterra's average R&M spend as % of total replacement cost of Fonterra's fixed assets for its manufacturing sites over the period F09 – F12. Total replacement cost of Milk Price asset base. (In both cases excluding collection assets & R&M.)	Calculate Fonterra's average R&M spend as % of asset replacement cost to replacement cost of equivalent Milk Price assets over the period F09 – F12. Apply the average ratio to the replacement cost of the relevant NMPB assets, to derive the Milk Price R&M provision.	That there are not material differences in average R&M spend, as a percentage of replacement cost, across (a) milk price vs. non-milk price assets, & (b) across assets older than those included in the Milk Price asset base vs. assets with lives equivalent to those included in the Milk Price asset base. That the assumed level of R&M spend is consistent with the revised assumption that no 'birthday capex' allowance is required.

This review has focused on the MP Model treatment of:

- The R&M cost assumptions.
- The overlap between R&M costs and capital treatment of maintenance.
- Birthday capital expenditure.
- Asset life and replacement cost assumptions.

6.2 Review of R&M costs

6.2.1 Fixed R&M costs

The MP Model calculates the annual R&M costs of the Notional Processor by applying a percentage to the total insurance asset replacement value. This percentage is calculated in the MP Model (Cash Cost Model) by:

- Dividing the actual annual R&M expenditure by the asset insurance replacement cost for all relevant Fonterra sites.

[5] 'Reasons' Paper in support of Fonterra's base milk price for the 2012/13 Season. 1 July 2013.

- This percentage value across the sites is averaged over the last four years (FY09 – FY12) for which actual data is available.

The total R&M related fixed operating cost for the manufacturing assets included in the MP Model for F13 is approximately $115 million.

Given the size of the accounting register and the difficulty in establishing clear boundaries between line items and items costed separately by GEA, Parsons Brinckerhoff has not audited the scope of the actual R&M costs contained in the spreadsheet “F13 R&M Update.xlsx”. It is possible that some of these R&M costs from actual Fonterra plant include costs relating to components not included in the Notional Processor business (e.g. related to cheese), however it is unlikely that these costs are material.

Parsons Brinckerhoff understands that Fonterra contract in a significant amount of R&M related work, and it would be considered important to confirm that these costs have been captured in the fixed R&M operating cost totals.

In the review of replacement cost values used in the MP Model, two different replacements cost related terms are used:

- Gross Current Replacement Cost.
- Total Insurance (Reinstatement) Value.

The Gross Current Replacement Costs used in the Cash Cost Model, are derived from the calculations made in the Capital Cost Model. Given the size of the asset register and the difficulty in establishing clear boundaries between line items and items costed separately by GEA, it is difficult to verify whether the basis for replacements costs contained in the Capital Cost Model is identical with the basis for deriving the insurance valuations (Total Reinstatement Values) contained in the spreadsheet “F13 R&M Update.xlsx” however any inaccuracy is unlikely to be material.

6.2.2 Birthday Capex

The Capital Cost model currently sets out the costs associated with the birthday capex for the Notional Processor. They are assumed to occur 15 years from the time plant is built, and a cost equivalent to 40% of the original cost (indexed) is incurred. The F13 MP Model only assumes birthday capex loading for assets notionally acquired in 1998 or earlier, and no birthday capex loading for assets assumed to be acquired after 1998.

The Milk Price Panel Paper dated 18 May 2012 recommended removing the birthday capex allowance and increasing the R&M provision in line with actual Fonterra R&M expenditure resulting in a small increase (approximately 0.3 cents) in the FGMP. The reason given for this change in methodology is to better reflect Fonterra’s maintenance strategy of extending asset lives using regular, routine expenditure rather than opting for large one-off capitalised refurbishments or overhauls. Parsons Brinckerhoff considers this is appropriate for the nature of the larger plant components which contribute the larger costs towards the subsequent FGMP calculation.

6.3 Significance of review

We have no reason to question the choice of Fonterra sites for calculating the R&M fixed operating cost percentages, and so there is no reason why this selection should not provide a reasonable representation of the level of R&M costs associated with the Notional Processor sites.

Parsons Brinckerhoff has not audited the source of the insurance replacement cost totals contained in the Fonterra spreadsheet “F13 R&M Update.xlsx”, for deriving the percentage value to represent fixed R&M operating costs, and the scope of associated costs. While there is the potential for the both the R&M costs

and the insurance RC values to be overstated (when compared to the assets of the Notional Processor), the net effect is not likely to be material.

7. Summary

7.1 MP Model input review summary

The following summary table is intended to provide an overview of review findings for the MP Model cost components.

Table 7.1 MP Model input review summary

MP Model input	PB report section	Description	Actual or Notional	Practically feasible for an efficient processor	Review outcome
Capital costs of Standard Plant	Section 4	A gross replacement cost assigned to each type of plant (WMP, SMP, BMP, AMF and Butter) in the MP Model.	Notional SMP and WMP plants derived from original 2008 GEA quotes, subsequently adjusted. AMF, Butter and BMP plants are derived from valuations for Fonterra reference sites. Site Services derived from original replacement cost valuations for actual Fonterra reference sites.	The lack of a clear fixed asset register for major plant components allocated to each site/plant type introduces uncertainty around the level of costs included. Given the issues identified in the report, practical feasibility has not been demonstrated.	MP Model should include: ▪ Feasibility study ▪ Fixed asset register ▪ Review of reference sites for establishing standard plant values.
Number of Standard Plant	Section 3	The number of plant by type (WMP, SMP, AMF, Butter and BMP) comprising the notional commodity business.	Notional Number of Standard Plant required to process the RCPs is based on the notional capacity of the Standard Plant	Yes.	Number of plant should be driven by required plant capacity analysis outcomes (for all types of plant), plus a consideration of historic variability of RCP allocations.

MP Model input	PB report section	Description	Actual or Notional	Practically feasible for an efficient processor	Review outcome
Standard Plant Capacity	Section 3	The processing capacity of each plant type (WMP, SMP, AMF, Butter and BMP) used in the notional commodity business.	Notional	Based on the weighted average capacity of existing Fonterra sites (safe harbour assumption).	Potential to skew standard plant capacity to reflect Fonterra actual site capacities, rather than reflect the required capacity of the standard plant required by the Notional Processor to make the RCP volumes. (E.g. BMP plant over capacity).
Energy usage rates: - kWh per MT of product - Tonnes (Steam) per MT product	Section 5	Used to calculate the annual energy consumption of the Notional Processor which is then applied to the energy cost rates to derive annual energy cost.	Notional Based on plant characteristics, scaled by independent reviewer.	No. Potential issue with using theoretically achievable rates of energy consumption based on equipment supplier data in comparison with using actual energy usage data.	Further comparison of notional rates with actual rates for Fonterra plant of similar size to the Standard Plant size assumed in MP Model and on an annual average basis.
Energy cost rates: - $/kWh - $/tonne (steam)	Section 5	Applied to energy usage assumptions to derive the annual energy cost for the Notional Processor.	Notional Based on budgeted energy costs across existing Fonterra plant.	Yes	None.
Water cost rates ($/tonne)	Section 5	Used to calculate the annual water costs of the Notional Processor. Calculated per Standard Plant type. Applied to RCP production volumes. Uses actual Fonterra figures as at April 2011, with adjustments determined by Fonterra.	Notional. Based on prior year actual values, obtained across multiple sites, but for limited sample period.	Yes. Observes that sites display significant variability, and the data based on limited sample not necessarily representative of season.	Annual total consumptions, averaged across several Fonterra sites that manufacture main RCP's (WMP, SMP) would offer a better estimate
CIP, laboratory and consumables costs ($/tonne)	Section 5	Used to calculate the annual costs of the Notional Processor. Calculated per Standard Plant type. Applied to RCP production volumes. Uses actual Fonterra figures as at April 2011, with adjustments determined by Fonterra.	Notional. Based on prior year actual values, obtained across multiple sites, but for limited sample period.	Data based on limited sample, but costs are likely to be linearly related to actual production.	Recommend acceptance. It would be possible to ask GEA for independent assessment, but this would introduce separate uncertainties

MP Model input	PB report section	Description	Actual or Notional	Practically feasible for an efficient processor	Review outcome
Effluent costs ($/tonne)	Section 5	Used to calculate the annual effluent costs of the Notional Processor. Calculated per Standard Plant type. Applied to RCP production volumes. Uses actual Fonterra figures as at April 2011, with adjustments determined by Fonterra.	Notional. Based on prior year actual values, obtained across multiple sites, but for limited sample period.	Yes. Concern that data based on limited sample not necessarily representative of season.	Annual total consumptions, averaged across several Fonterra sites that manufacture main RCP's (WMP, SMP) would offer a better estimate.
Repairs and Maintenance cost (Operating cost)	Section 6	Classified as a fixed operating cost in the MP Model. Calculated as a percentage of the gross current replacement cost of the assets of the Notional Processor.	Notional Based on the last four years of actual R&M costs for relevant Fonterra sites. Derived from two key inputs: - actual R&M costs - asset insurance replacement costs	Should generally be representative of actual R&M operating costs for the Notional Processor providing the source Fonterra information is capturing accurate and complete data (i.e. including contracted R&M).	It is possible that R&M costs from actual Fonterra plant include costs relating to components not included in the Notional Processor business (e.g. related to cheese), however it is unlikely that these costs are material.
Birthday capex	Section 6	A capital allowance for the one-off expenditure for major overhaul of plant. The model assumes expenditure equal to 40% of the initial inflation-adjusted cost will be incurred in year 15 of a manufacturing plant's life, and adds the present value of this amount to the asset's original cost.	Notional Derived from Gross Current Replacement Costs.	Yes.	In order to avoid duplication of costs with R&M operating costs, suggestion to remove birthday capex and increase R&M operating cost allowance in model update is reasonable. This should also facilitate testing of actual Fonterra plant R&M costs against the level of costs assumed for the Notional Processor.