

3. Supply Side – TNRP All Quarries Database

No. Of Hard Rock Quarries

An 'All quarries' TNRP (hard rock) database has been created by merging DTMR's "All Quarries" database with DEEDI's Quarry Production database (which lists quarries that have reported production in recent years).

The original DTMR 'All Quarries' database listed 332 quarries across Qld. with either an active, inactive or potential status.

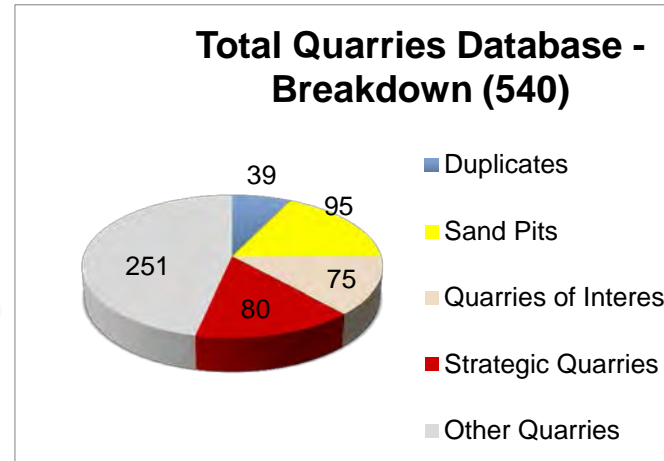
Following desktop review and ground-truthing as necessary, it was found an overlap of 121 quarries existed between these 2 databases.

Furthermore, an additional 16 new hard rock sites or resources were identified as a result of market intelligence and consultations with industry.

The net result is that the study has identified 406 hard rock quarry sites across Queensland that can (or will be able to) produce crushed rock products.

(i.e. Total Quarries (540) less sand pits (95) less duplicates (39) = 406).

Refer slide overleaf for reconciliation



Note: The sand pit data is that provided in the DTMR database, and has not been updated as part of the TNRP project.

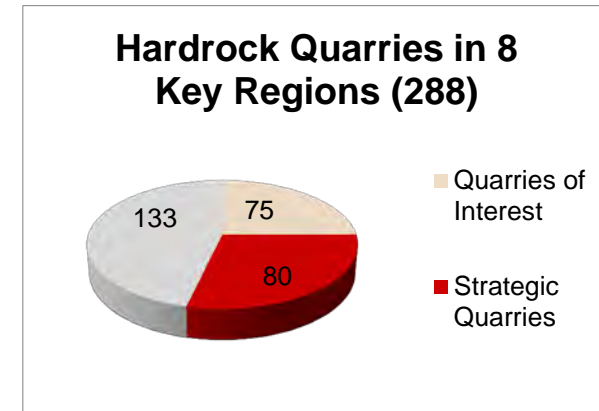
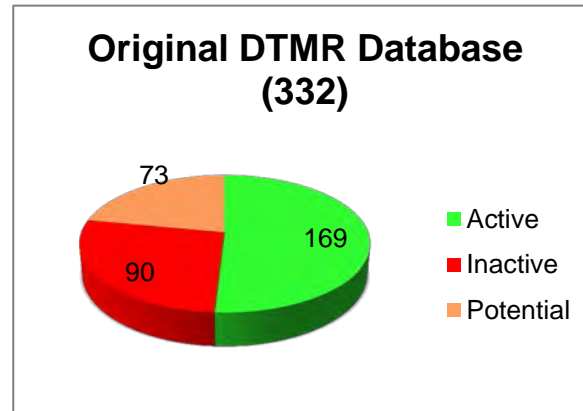


FIGURE 3: HARD ROCK QUARRIES DATABASE - SEGMENTATION

QUARRIES OF INTEREST AND STRATEGIC QUARRIES

Of the 406 hard rock quarries on the TNRP All Quarries database, 288 or 71% are located in the eight (8) regions of interest, which are the focus of this study. Of these 288 sites, 80 have been identified as 'Strategic Quarries' for the TNRP; an additional 75 quarries are 'Quarries of Interest'; 48% of Strategic Quarries have pre-coat plants and about 10% have CTB/pugmill plants.

The 'origin' of the hard rock quarry sites in the updated Qld All Quarries database, is shown in **FIGURE 4: HARD ROCK QUARRIES – ORIGINS**.

One of the principal differences between the DEEDI Quarry Production database and DTMR Quarries database is that the DEEDI database includes local government gravel pits, many of which usually supply local government (internal) needs only.

Note that 16 'new' quarry sites have been added to the revised database.

These new quarry sites are either:

- i) Soon to commence production;
- ii) Have a development application in progress/pending; or
- iii) They represent known sites that have been developed to supply critical infrastructure (eg dams, railway, coal mines etc) and there are good prospects that they could be 'activated' to supply TNRP works, if required.

Not all of the 'new' quarries are 'Quarries of Interest' or 'Strategic Quarries'.

NOTES ON 'NEW' QUARRY SITES
 A total of sixteen (16) 'new' sites have been added to the database. These sites have been suggested either by industry or by study team members.

Those sites where the location of the quarry or quarry site is known (or approximately known) have been included in the 16 'new' quarries.

Most of the 16 'new' identified quarry sites do not yet have development approval but are in the process of applying to receive lease approval/development consent.

They occur across all of the CDA's eg FNR, NWR, FTR, MWR, SWR and DDR.

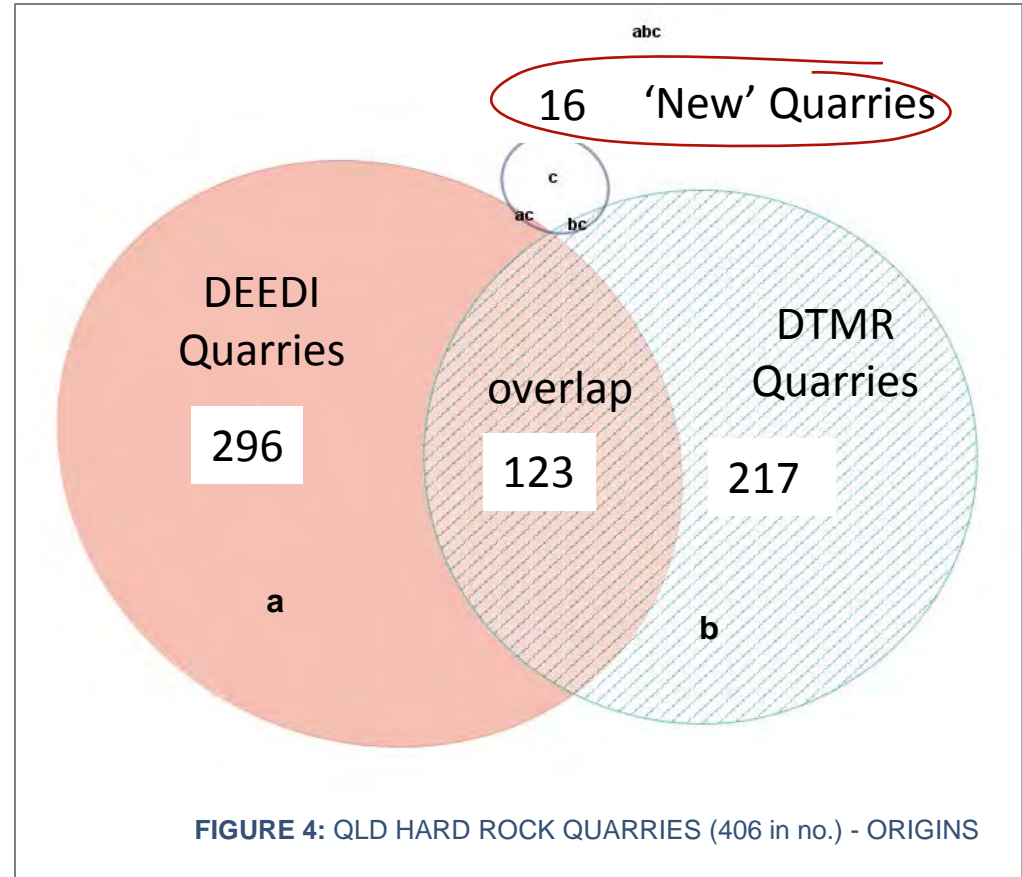


FIGURE 4: QLD HARD ROCK QUARRIES (406 in no.) - ORIGINS

DIFFICULTY IN GAINING APPROVAL FOR A NEW QUARRY

For quarry development applications under SPA 2009, in coastal regions it can typically take 3 years and at least \$0.5M in EIS and application costs, to gain approval, assuming there is no challenge to an approval decision. Many quarry development approvals (even extensions) are challenged in some form in the courts. It is therefore simply impractical to expect that 'greenfield' quarry sites could be approved and brought into production within the 2014 timeframe of the TNRP, unless the applications are already advanced and critical tenure issues in regional Queensland such as native title have been properly addressed. For these reasons, in assessing potential or 'new' extractive resources the study has focussed on 'brownfield' sites or prospective quarry sites already under investigation or 'activation' by the marketplace.

TNRP ALL QUARRIES DATABASE – METADATA

The fields of information contained in the TNRP All Quarries database are shown in Table 3.

In addition to the ‘standard’ quarry details and information, additional fields have been added based on information contained in the DEEDI Quarry Production Database.

The (yellow) highlighted fields at the bottom of the metadata list relate to specific information on the discretionary supply capacity of quarries to service TNRP projects in addition to their existing customers and commitments.

These discretionary supply estimates are highly-conditional and must be reviewed regularly, if they are to have any meaning or utility.

The capability to produce pre-coated aggregates and CTB is also recorded along with notes from research and discussions with the quarry.

TNRP ALL QUARRIES METADATA

The ‘standard’ fields include quarry status, quarry name, location, operator details, geology, source rock, and approved product types. New fields have been added which address annual production (H,M,L) where known, and product availability by product type.

DISCRETIONARY SUPPLY TO TNRP

These fields are specific to the TNRP quarry supply assessment – the fields are used to record indications/capabilities for (conditional) discretionary supply & precoat and CTB capabilities

TABLE 3: TNRP ALL QUARRIES DATABASE – METADATA

FIELD NAME	DATA TYPE	EXPLANATION
TNRP_ID	Small integer	Unique identifier for the TNRP All Quarries database
Current_Status	Character 9	Assessment of current operational status for TNRP
Hardrock_Sand	Character 9	Products derived from either hard rock or sand deposits
DTMR_Activity	Character 10	DTMR assessment of quarry activity: active, inactive or potential
DEEDI_Status	Character 11	DEEDI assessment of status: operating, approved, suspended, application
DTMR_ID	Small integer	Unique quarry ID assigned by DTMR in order of activity
DEEDI_ID	Small integer	Unique quarry ID assigned by DEEDI
Duplicates	Character 9	Assigned assessment of duplicate quarry for TNRP
Current_Name	Character 36	Assigned name for quarry based on DTMR and DEEDI names & field data
DTMR_Quarry_Name	Character 30	DTMR assigned name for quarry
DEEDI_Quarry_Name	Character 30	DEEDI assigned name for quarry
Operator	Character 30	Quarry operator according to DEEDI and field observation for TNRP
Region	Character 17	DTMR region in which the quarry is located
Lat	Float	Latitude in digital degrees (GDA94 datum) of quarry location
Long	Float	Longitude in digital degree (GDA94 datum) of quarry location
Local_Government	Character 30	Local government area in which quarry is located
DTRM_Source_Rock	Character 40	DTMR assessment of rock type exploited in quarry
DEEDI_Rock_Type	Character 30	DEEDI assessment of rock type exploited in quarry
Lith_Description	Character 254	Lithology at quarry site derived from GA mapping
Unit_Symbol	Character 6	Unit symbol of geological unit from GA mapping
Unit_Name	Character 30	Name of geological unit at quarry from GA mapping
Expiry_Date	Character 10	Quarry license expiry date from DTMR data
DEEDI_Production_Rate	Character 8	Quarry production rate assigned by DEEDI: high, medium, low
Notes	Character 60	Notes on location and activity from Google Earth imagery
Map_100K	Character 8	National 1:100,000 scale map sheet on which quarry is located
DTMR_Nom_Products	Character 200	DTMR listing of quarry products available
DEEDI_Products	Character 80	DEEDI listing of quarry products available
ConcreteAgg	Character 1	Availability of concrete aggregate products (True or False)
CoverAgg	Character 1	Availability of cover aggregate products (True or False)
RailBallast	Character 1	Availability of rail ballast products (True or False)
eq_greatT2_1UPM	Character 1	Availability of Type 2.1 UPM or superior (True or False)
lessT2_1UPM	Character 1	Availability of roadbase inferior to Type 2.1 UPM (True or False)
FineAgg	Character 1	Availability of fine aggregate products (True or False)
Riprap	Character 1	Availability of riprap products (True or False)
Other	Character 1	Availability of other products (True or False)
Quarry_of_Interest_TNRP	Character 1	Quarry identified as being of interest to TNRP (True or False)
Strategic_for_TNRP	Character 1	Quarry of priority interest and strategic value to TNRP (True or False)
T2_1andT2_2_DiscrSupply	Float	Discretionary production rate of Type 2.1 and Type 2.2 UPM combined (tpm)
Cover_Agg_Discr_Supply	Float	Discretionary production rate of Cover Aggregate (tpm)
Pre_Coat_Facility	Character 1	Presence of a pre-coating facility (True or False)
CTB_Pugmill_Facility	Character 1	Presence of a cement-treated base/pugmill facility (True or False)
Notes_Discr_Supply	Character 181	Field notes relating to discretionary supply

A critical outcome for the study has been to identify from the TNRP All Quarries database those quarries which can supply or are already supplying TNRP project work, and those quarries (or resources) which have the potential to supply Type 2.1 (2.2) and /or cover aggregates.

These ‘strategic quarries’ and ‘quarries of interest’ are crucial to the flood reconstruction works.

Because they operate under various influences of existing or foreseeable supply constraints and business pressures and strategies, they vary in their capacities to provide discretionary supply to TNRP and Qld RA works.

Nevertheless, the quarries themselves have indicated that the most significant difficulty they face is inadequate notice of the timing to supply Main Roads projects.

These and other supply side issues and/or constraints along with suggestions to address them, are summarised in TABLE 2 (page 8) and discussed in the final section of this report.

STRATEGIC QUARRIES AND QUARRIES OF INTEREST

Strategic Quarries in most instances are established hard rock quarries with a record of supply of roadbase and /or cover aggregate (or equivalent materials) and which have indicated (or it can be reasonably inferred there is) a preparedness to supply TNRP projects with Type 2.1 (2.2) roadbase and/or cover aggregate materials. Note that of the 80 Strategic Quarries, only 38 or 48% indicated they have pre-coating facilities.

There are important conditions or constraints to supply from Strategic Quarries which need to be overcome, but Strategic Quarries represent those quarry sites which are expected to supply the ‘lion’s share’ of TNRP quarry materials over the 2011 to 2014 reconstruction period.

‘Quarries of Interest’ are candidate sites drawn from the ‘TNRP All Quarries’ database where discretionary capacity is less well-known, but there is good potential for some discretionary supply. These quarries should be investigated as prospective supply sources of roadbase and/or aggregates. Some are expected to become ‘Strategic Quarries’.

Hardrock Quarries in 8 Key Regions (288)

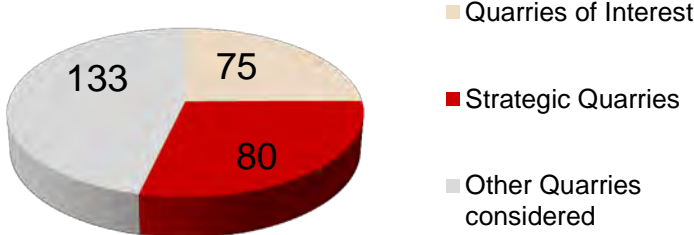


FIGURE 5: QLD HARD ROCK QUARRIES in the 8 REGIONS OF INTEREST

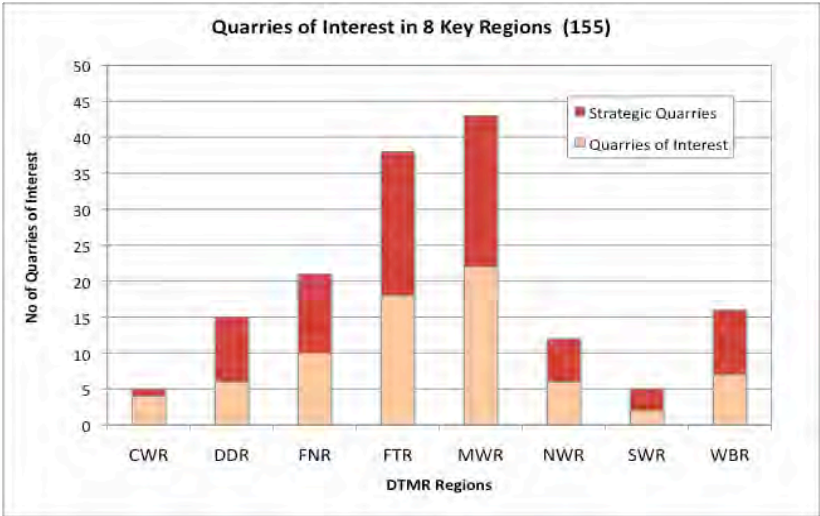


FIGURE 6: STRATEGIC QUARRIES AND QUARRIES OF INTEREST BY CDA

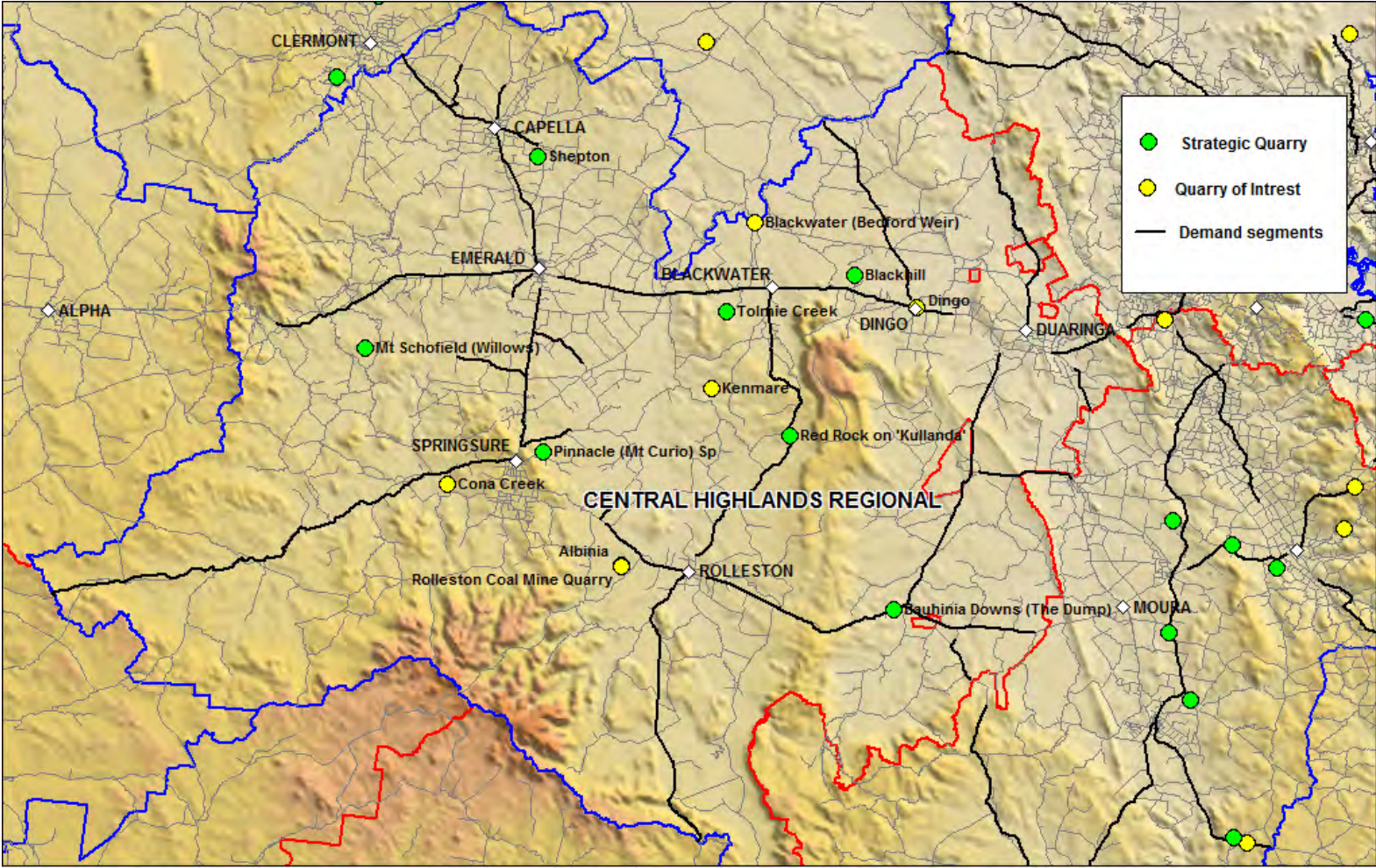
Strategic Quarries and Quarries of Interest for the Central Highlands LGA within the Fitzroy region are shown in Figure 7.

The damaged road segments requiring roadbase and aggregate materials over the period 2011 to 2014 are shown in black.

The TNRP All Quarries database indicates there are seven (7) strategic quarries in the Central Highlands Regional Council local government area, and six (6) quarries of interest.

The 3 largest operating quarries in the west are Shepton (CHRC), Tolmie Ck (Holcim) and Blackwater. Other 'campaign' quarries such as Mt Schofield and Blackhill are in strategic locations.

Quarries of Interest such as Cona Ck (resource not known but in a strategic location) and Albinia Quarry (within the boundary of a National park) are also strategically located, but constraints to supply may be intractable.



Source: All Quarries Database draft Jan 2012

FIGURE 7: STRATEGIC QUARRIES AND QUARRIES OF INTEREST for CENTRAL HIGHLANDS LGA, FITZROY REGION

Figure 8 shows a typical 'production sold' profile, by year, and product type, for a quarry working a Tertiary Basalt deposit. Established quarries in established areas typically produce a range of crushed rock products depending on market demand and source rock quality.

Quarries use both fixed and mobile crushing and screening plant (processing plant) to produce roadbase and aggregate materials.

Fixed installations are used in established quarries with established markets.

Mobile plants are also used in established quarries (to increase production) but most typically for 'campaign crushing' where the quarry is worked on an 'as required' basis depending on demand from local projects.

The portability of mobile plants is their advantage, but there are 'trade offs' – they are usually less efficient, are harder to maintain (with attendant risk implications) and more costly to operate.

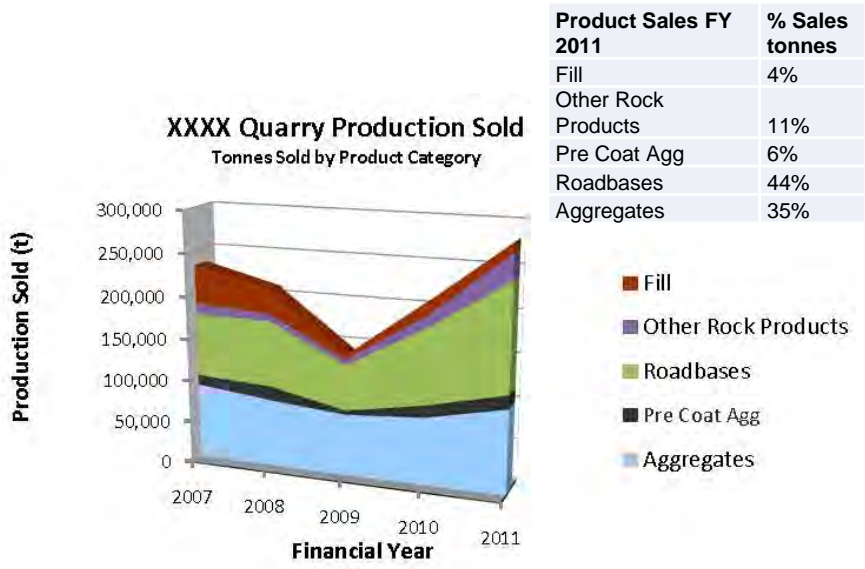


FIGURE 8: EXAMPLE OF ANNUAL QUARRY PRODUCTION

FIXED V MOBILE CRUSHING & SCREENING PLANT

Fixed plants have a high capital cost (\$6M to \$60M depending on size and sophistication) but their productivity is higher, with availabilities as high as 90% in some modern plants.

Mobile plants cost about \$6M for a 180-200 tph (2000 tpd) Type 2.1 roadbase plant (which can be easily reconfigured to produce 1500 tpd of aggregate). But the availability of these plants varies widely depending on application, age and the capabilities of the operator.

Industry report that availabilities (as low as 50% but) typically 60-65% as the norm in some regional areas of high demand. Naturally, this has a profound impact on what a plant can produce - month in month out. In the discretionary supply analysis for this study, estimates of monthly (conditional) discretionary capacity have been made, taking availability considerations into account.



Basalt and igneous rocks comprise the majority of source rocks in the Strategic Quarries and Quarries of Interest. The basalt quarry in the photo is using a mobile 170 tph crushing plant in the pit. Note the soil and overburden in the foreground and the different (dark and light) basalt materials in the rockface indicating variable quality.

Both overburden and the presence of altered rock can impact on product quality and cost.

4. Supply Side – Example of Crushing and Screening Circuit

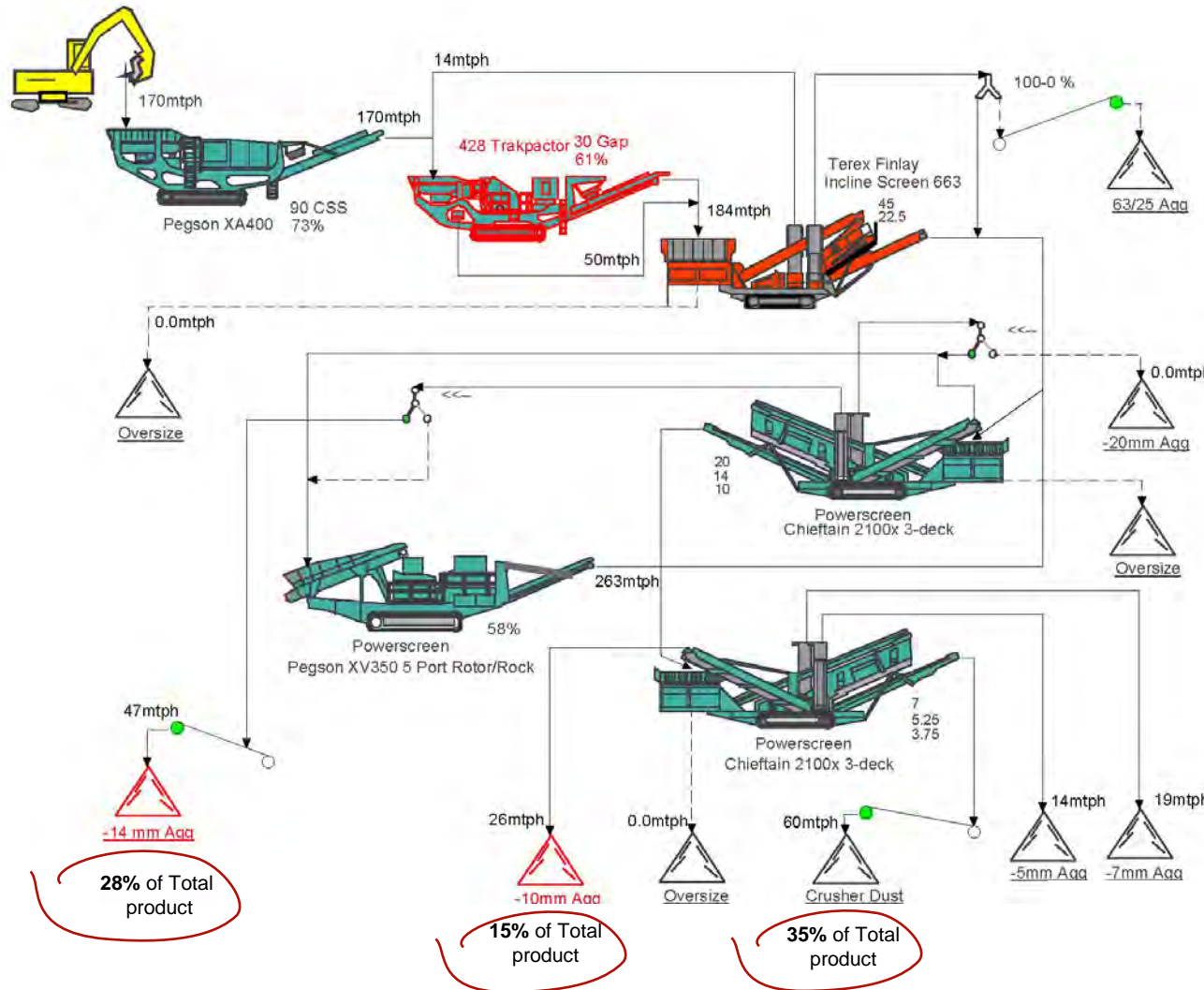
Aggregate configuration and Product Yield

FIGURE 9 consists of a schematic diagram of a 170 tph mobile crushing and screening circuit, for a Basalt quarry producing roadbase, and aggregate (80% asphalt agg. and 20% cover aggregate).

The circuit shows the asphalt aggregate configuration and the 'yield' of each size fraction (in tonnes per hour).

In this circuit, crusher dust accounts for 35% of production, 28% is 14mm aggregate and 15% is 10mm aggregate. The actual yield of 16mm, 14mm and 10mm cover aggregate from the primary raw feed for a quarry is therefore a fundamental constraint to increased output.

Some quarries (particularly those that produce rail ballast) have commented that they can make roadbase and aggregates from the 'undersize' from rail ballast and it would help improve yield for 16mm pre-coat if a larger maximum particle size could be tolerated in the specification.



Source: MD Cooper Consulting Pty Ltd - Aggflow

FIGURE 9: EXAMPLE OF CRUSHING & SCREENING PLANT CIRCUIT

For the above circuit, 10mm aggregate comprises just 15% of total aggregate production.

PRE-COATED AGGREGATE

Precoating is the pre treatment of the aggregate with a thin film of bitumen compatible material, generally a petroleum based product, to:

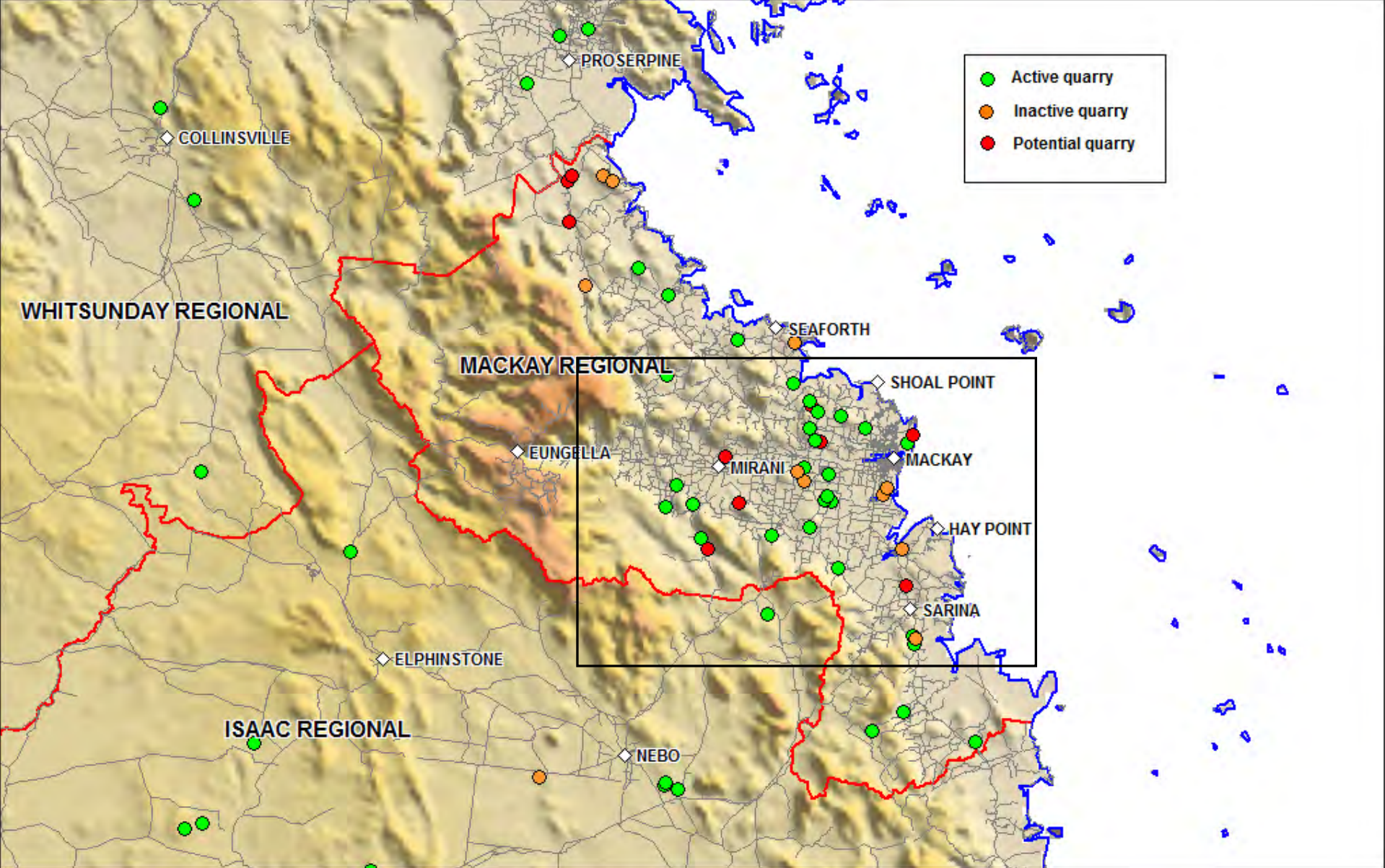
- i. Neutralise the effect of dust;
- ii. Aid the initial "wetting" of the aggregate by the binder to improve the early retention of the aggregate and;
- iii. Improve the bond of the binder to the aggregate.

The aggregate's surface chemistry and the presence of dust and water affect the bond between binder and aggregate.

Source: www.austroroads.com.au

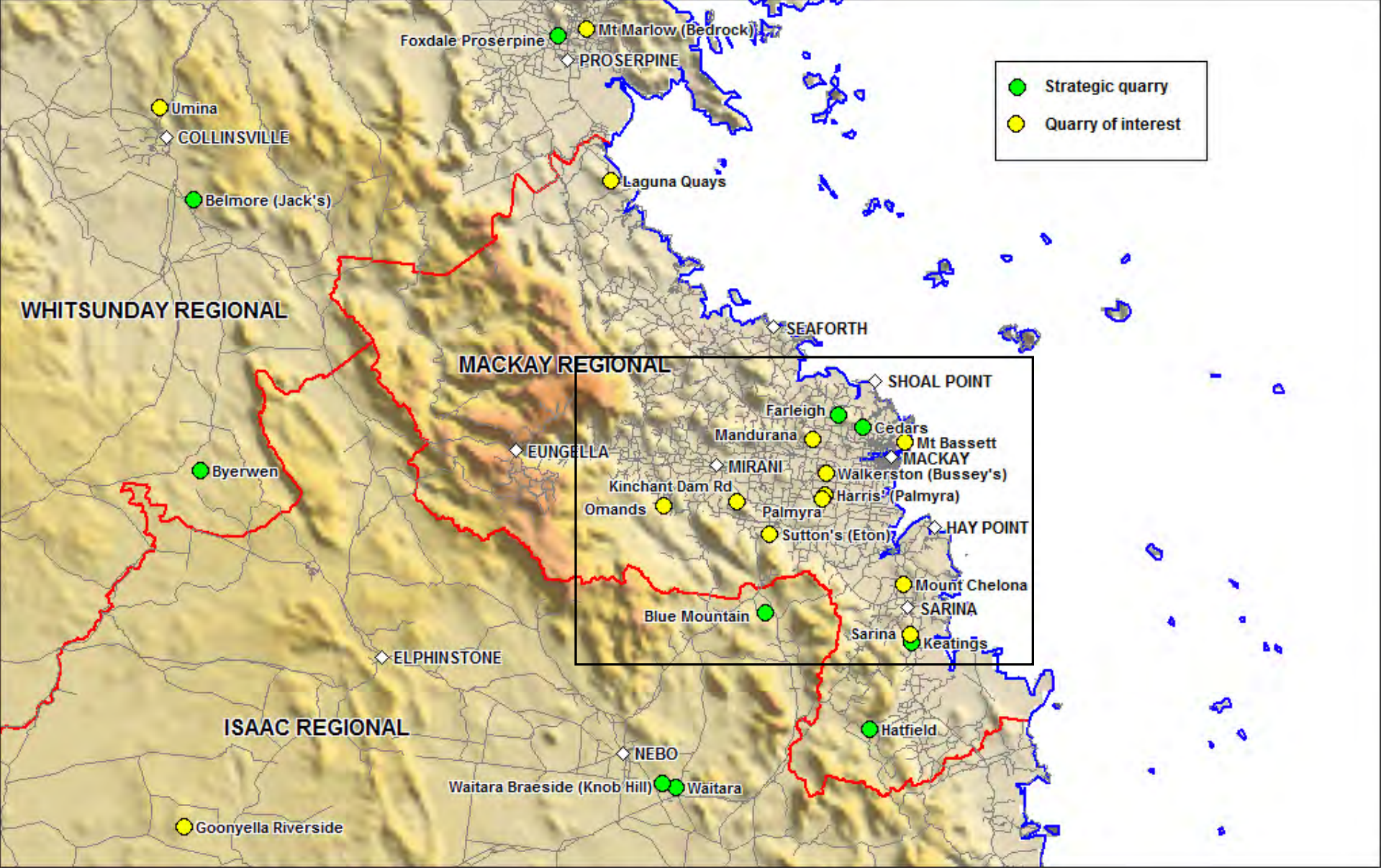
Note that only 38 (48%) of Strategic Quarries have indicated they have pre-coating facilities.

FIGURE 10: ALL QUARRIES DATABASE – ACTIVE, INACTIVE AND POTENTIAL HARD ROCK QUARRY SITES, MACKAY & SURROUNDS



Source: All Quarries Database, draft v7

FIGURE 11: TNRP ALL QUARRIES DATABASE – STRATEGIC QUARRIES & QUARRIES OF INTEREST, MACKAY & SURROUNDS



Source: All Quarries Database, draft v7