In terms of Section 28 of the EIA Regulations (GNR. 543 of June 2010), as amended, due consideration must be given to project alternatives during the EIA process. The Regulations define "alternatives" as: *"In relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to":*

a) The property on which or location where it is proposed to undertake the activity;
b) The type of activity to be undertaken;
c) The design or layout of the activity;
d) The technology to be used in the activity;
e) The operational aspects of the activity; and
f) *The option of not implementing the activity" (the 'no-go' option).*

Section 31 (2) (g) of the EIA Regulations (GNR. 543 of June 2010), as amended, requires a description of feasible and reasonable alternatives to be considered in the EIA Report. In part, the purpose of the Scoping Report is to review and screen alternatives to determine reasonable and feasible alternatives that need to be assessed in further detail in the EIA Report. In essence, an alternative is a different means to meet the general purpose and need of an action. In terms of the EIA Regulations (GNR. 543 of June 2010), as amended, alternatives could include, amongst others, the following.

- Activity alternatives – also referred to as project alternatives. This requires a change in the nature of the proposed activity. This category of alternatives is most appropriate at a strategic decision–making level. This includes the 'no-go' option.

- Location alternatives – alternative locations for the Project, or for components of the Project proposal (i.e. on-site location alternatives).

- Process alternatives – also referred to as technological or equipment alternatives. The purpose of considering such alternatives is to include the option of achieving the same goal by using a different method or process.

- Site layout alternatives – site layout alternatives permit consideration of different spatial configurations of an activity on a particular site.

The following section provides an overview of the various alternatives considered during the design phase and within the EIA process, these include:

- site location alternative;
- site layout alternative;
- technological alternative; and
- no-go alternative

5.1 SITE LOCATION ALTERNATIVES

As part of the site selection process a number of potential sites were investigated, through a desk-top analysis. The preferred site was identified and selected based on a number of criteria, including:

- a site with an area of 3.5 ha or more;
- environmental constraints;
- water demand requirements, the proposed facility would require 900 kiloliters per month if both plants should be online;
- electricity requirements, the plant requires approximately 0.75megawatts (MW);
- easy access to major roads and highways; and
- a site with existing industrial rights.

There were four other site locations considered during the scoping phase; however these sites have been scoped out due to technical, financial and environmental constraints. A summary of these sites and associated constraints have been provided in *Table 5.1.*

Table 5.1 Summary of Alternative Site Locations and Constraints

Site Details	Site Constraints
Nigel Located on 1st Ave, off the R42 Site Coordinates: 26°24'17.54"S 28°28'27.77"E	From a land-use perspective, this site location was characterised by a high density (ie high number of land-use activities surrounding the site) of other businesses, industries and land-users. This would result in similar off-site risks as the existing acetylene facilities. According to the National Water Act (Act No. 36 of 1998), no development may take place within the 1:100 year floodline or within 500m of a stream/tributary without a Water Use Licence Application. This site is located approximately 390m west of the Nigel Dam. This site would have therefore required a Water Use Licence application due to its proximity to the dam. There were also financial constraints regarding the procurement of the site.
Heidelberg 1 Located at the corner of Loveday and Schuins Streets Site Coordinates: 26°31'15.42"S 28°21'41.49"E	According to the National Water Act (Act No. 36 of 1998), no development may take place within the 1:100 year floodline or within 500m of a stream/tributary without a Water Use Licence Application. There is a tributary/stream located 330m east of the proposed site. This site would have therefore required a Water Use Licence application for its proximity to this tributary. There were also financial constraints regarding the procurement of the site.
Daleside Located along Graniet Road Site Coordinates: 26°30'45.72"S 28° 2'50.78"E	There was no easy access to the major roads (ie M61) and highways from this property. There were also financial constraints regarding the procurement of the site.

Site Details	Site Constraints
Heidelberg 2 Located off Albert Street Site Coordinates: 26°30'56.88"S 28°21'48.50"E	The southern boundary of this site is located 20m from a watercourse. According to the National Water Act (Act No. 36 of 1998), no development may take place within the 1:100 year floodline or within 500m of a stream/tributary without a Water Use Licence Application. If applied for, it would have been unlikely that the Department of Water Affairs would have approved such a development, especially as the site slopes south. Furthermore, this site was not considered to be easily accessible from the major roads/highways.

The preferred site location comprising Stands 88 and 89 of Valley Settlements Agricultural Holdings was chosen over these site locations for the following reasons.

- The Project site has an area of approximately 4.4ha which not only accommodates the total footprint of the facility but provides for a buffer which ensures a reduced off-site risk to surrounding land-users.

- There were no significant environmental constraints identified on this site, i.e. there are no watercourses or drainage lines on or in close proximity to this site.

- There is an existing 11kV electrical power line outside the site, which will be used to power the facility via a new substation.

- The R59 corridor has been identified as an industrial/commercial zone to attract potential investors to the Sedibeng District Municipality, in line with the Sedibeng District Municipality Spatial Development Framework. The Project site is easily accessed via the R59 and offers Air Products greater mobility to their various clients (ie Vereeniging).

- The Project site has already been zoned for industrial use 3, negating the need for re-zoning or any land departure applications.

5.2 SITE LAYOUT ALTERNATIVES

The site layout has undergone a number of iterations based on the technical aspects of the Project and environmental considerations explored during the EIA process. The position of the catchment pits has changed, they were originally proposed along the western boundary of the site (*Figure 5.1*); however the preferred layout is to install these catchments pits along the eastern boundary of the site (*Figure 5.2*). The purpose of these catchment pits is to collect and store surface water run-off for re-use in the facility process.

A comparison of both site layout alternatives according to the technical, financial, environmental and safety considerations is provided in *Table 5.2* below.

Table 5.2 Comparison of Site Layouts

Considerations	Site Layout 1 (Western Boundary)	Preferred Site Layout (Eastern Boundary)
Technical	The natural gradient of the site falls to the east. See *Figure 5.3*. Positioning the catchment pits along the western boundary would require significant site levelling and grading works.	With the natural gradient of the site falling to the east, there is no need for significant site levelling. The natural gradient would be enhanced by surface bed channels and drains that would direct all surface water run-off into the catchment pits.
Financial	Altering the natural gradient of the site would result in higher civil and construction costs.	There are no additional civil or construction costs associated with positioning the catchment pits along the eastern boundary of the site.
Environmental	The ecological sensitivity of the western area of the site is medium. This alternative does reduce the plant's water demand.	The ecological sensitivity of the eastern area of the site is medium. This alternative does reduce the plant's water demand.
Health and Safety	This site layout has an acetone tank located on the eastern boundary of the site, along Tilliet Road. Acetone tanks are associated with the risk of explosion and fire. As such, with the tank being located this close to the boundary there is a greater potential for off-site risks to adjacent land-users.	This site layout would result in an adequate buffer between the acetone tank and the site boundary. Furthermore the acetone road tankers used to transport acetone would have their loading facilities located further away from Tilliet Road. Generally the site layout has moved more centrally on the Project site, including, including the generator, compressors and cylinder storage areas. The potential off-site risks to adjacent land –users along Tilliet Road would there be significantly reduced.

Site layout 1 is not preferred due to the site works and associated costs required to alter the natural gradient of the site. Furthermore, this layout does have a higher safety risk associated with the position of the acetone tank and acetone road tanker loading point, close to Tilliet Road. By re-positioning these catchment pits to the eastern boundary of the site, it would negate the need for site works, additional costs and reduce the off-site risks to adjacent land-users. The preferred site layout is as indicated in *Figure 5.2*.

Figure 5.1 Site Layout 1 (Catchment Pits Along the Western Site Boundary)

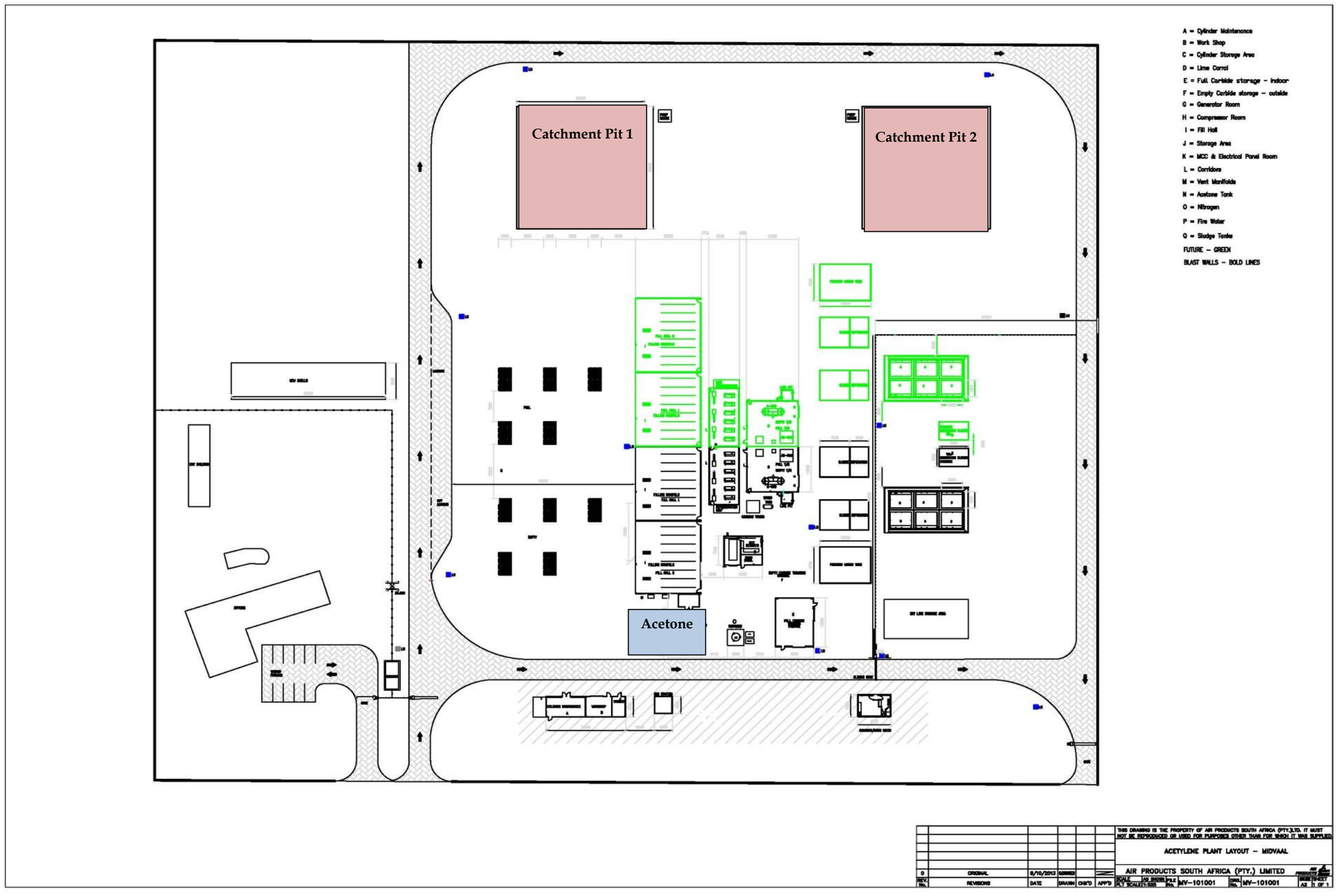


Figure 5.2 Preferred Site Layout (Catchment Pits Along the Eastern Site Boundary)

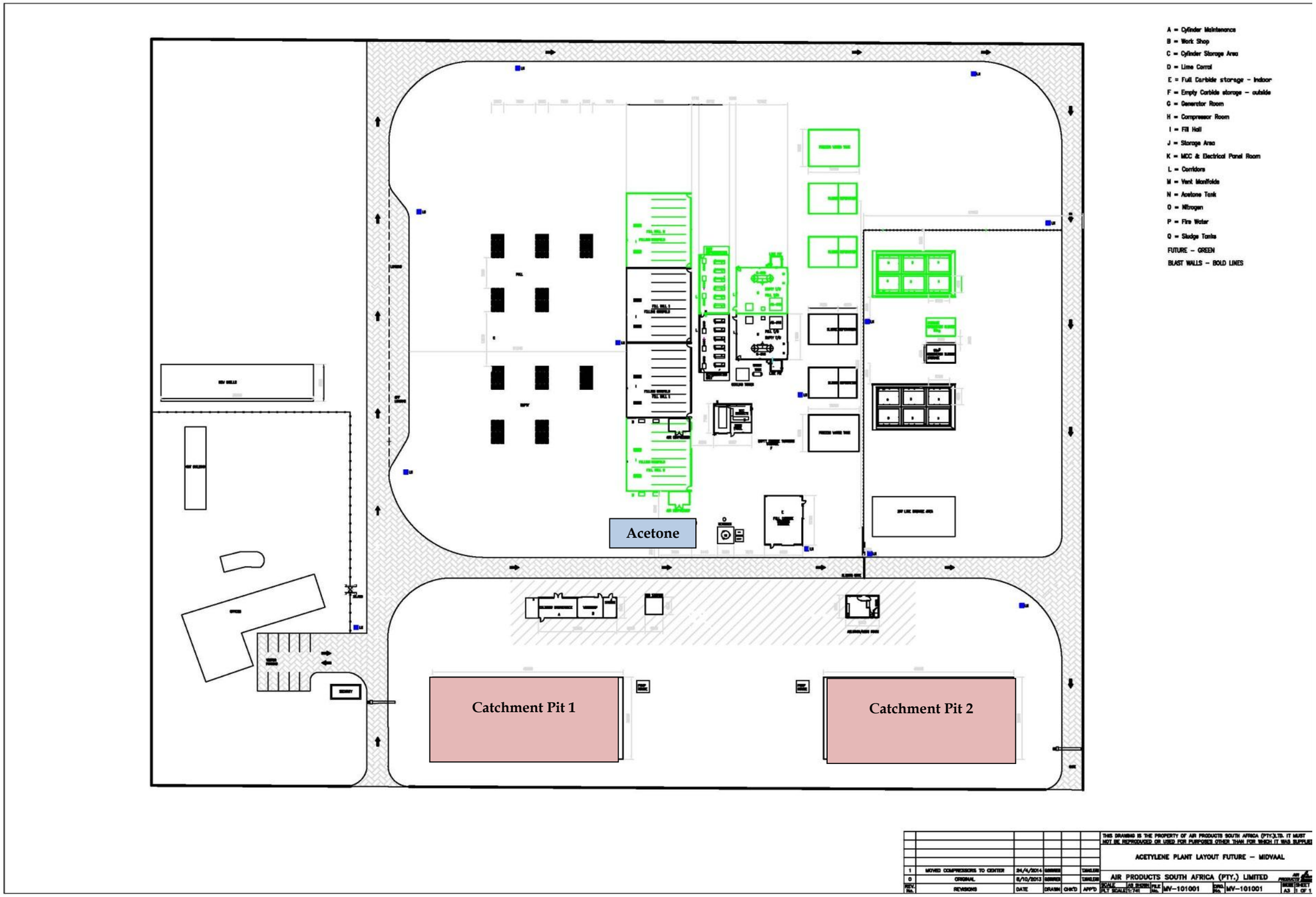
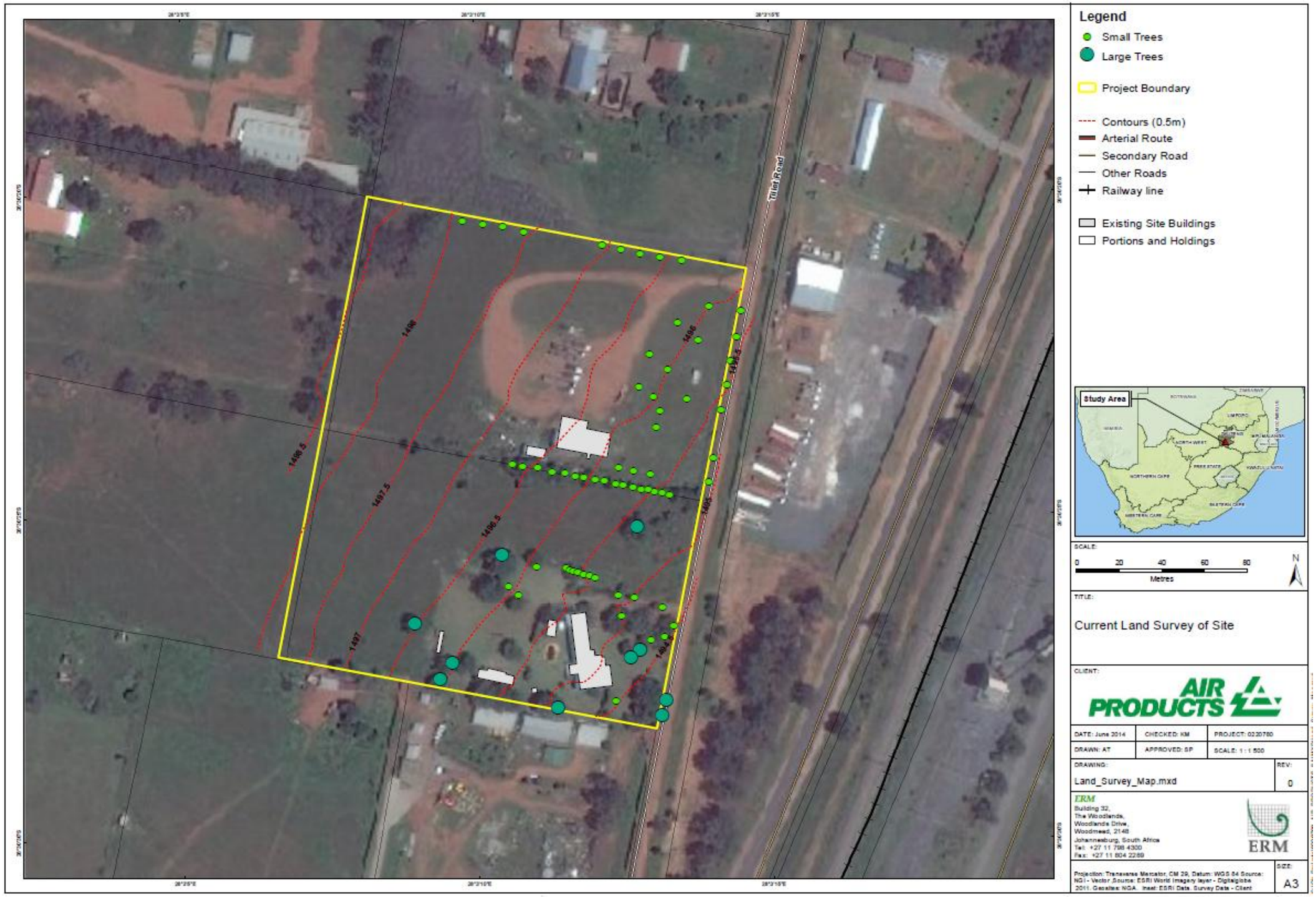


Figure 5.3 *Land Survey Map*



5.3 TECHNOLOGICAL ALTERNATIVES

There are 2 types of dryers used as part of the production process, namely a low pressure (LP) dryer and a high pressure (HP) dryer. These dryers are both required in the process as they serve different functions. The LP dryer serves to reduce the water content of the acetylene gas, whilst the HP dryer serves to ensure any residual moisture is removed from the acetylene gas.

This section considers technological alternatives of the HP dryer, these include:

- Non regenerative HP dryer which requires silica gel/calcium chloride as a drying agent; and
- Regenerative HP dryer which uses molecular sieves in a Pressure Swing Adsorption (PSA) system and does not require the use of any drying agents.

The sections that follow describe both types of HP dryers and highlight their associated advantages and disadvantages.

5.3.1 *Non Regenerative HP Dryer*

A non regenerative HP dryer consists of an oil/water separator and two vessels which contain either silica gel or calcium chloride. These materials serve as a desiccant, drying any substance that it comes in contact with. If calcium chloride is used as a desiccant, the rate of loss of this desiccant is a function of the pressure and the gas flow. The pressure should therefore always be maintained at a maximum of 1800 kpa. Furthermore, as the calcium chloride removes excess water from the acetylene gas, it becomes dissolved leaving a void in the vessels. If the vessels are not topped up regularly with calcium chloride, a hazardous void will develop which could potentially lead to an explosion. This system therefore requires continuous monitoring of the level of calcium chloride, which should not fall below 65 percent of the level of the drier.

The use of silica gel as a desiccant operates similarly, although the silica gel is not consumed, but when saturated it is replaced. This may be new silica gel or silica gel which has been regenerated, therefore large quantities of this desiccant is required. Whilst silica gel is considered to be a chemically inert material, the use of the silica gel would require regular maintenance of the process facility to remove residual materials from the drying process, therefore similar controls and monitoring is required for silica gel as for calcium chloride.

Furthermore, silica gel is a high cost agent with its adsorption efficiency dependant on various factors such as temperature of the gas (ie the silica gel is only effective at room temperature (25^{o}C) or below).

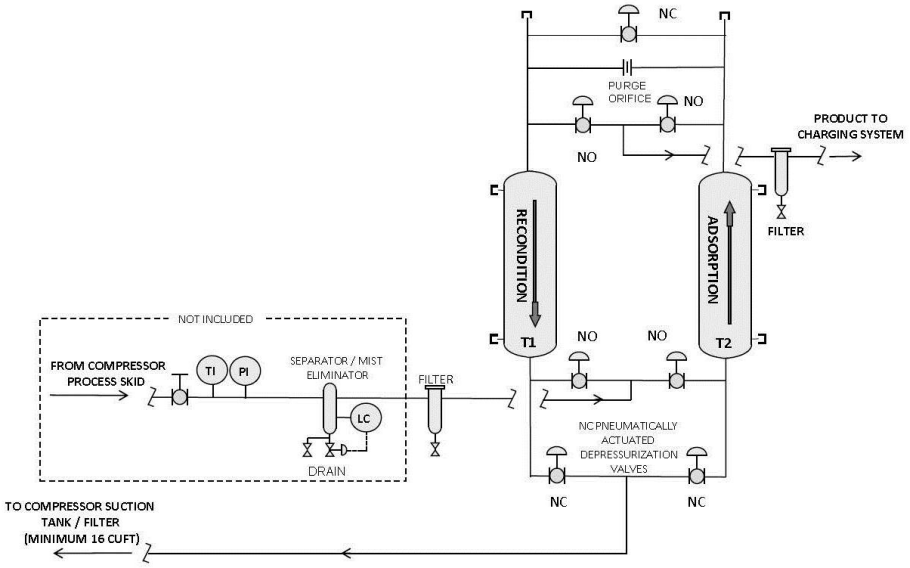
The advantages of this non generative HP dryer system are that it is relatively inexpensive to purchase and install; however the disadvantages are:

- high operating cost from the maintenance required and lost production from temporarily shutting down the plant;
- lack of desiccant and consequential hazard of a void which could result in an explosion;
- wet acetylene gas and subsequent contamination of the acetylene cylinders;
- leaks from the filling caps of the driers as the threads wear; and
- corrosion of the vessels and pitting of the walls.

5.3.2 Regenerative HP Dryer

The PSA system comprises of 2 tubular cylinders with activated alumina beds and is based on the process of adsorption. This system separates the acetylene gas from moisture (H_2O) using a set of molecular sieves that capture molecules of hydrogen and oxygen whilst the acetylene gas passes through the sieves. Once the sieves are saturated, these captured molecules are drawn out of the system at a low pressure. This moisture is returned to the generator tank for re-use. This is a two vessel system, while one vessel is releasing the captured molecules at low pressure; the other vessel is adsorbing the molecules from the acetylene gas at a high pressure. Hence the name of the system - pressure swing adsorption (*Figure 5.4*).

Figure 5.4 Typical Pressure Swing Adsorption System



Source: Air Products South Africa (Pty) Ltd (May 2014)

During operation, each adsorption bed will be online for approximately five minutes then switches over to recondition or dry. The system is repeated over the course of the production run. Molecular sieves produce a lower dew point or moisture content; however the correct type of molecular sieve is important as hydrocarbons are adsorbed in preference to water. Acetylene is a hydrocarbon and will be adsorbed preferentially. Twenty percent of the production process is recycled back to the generator for the capture of the moisture.

The benefits of this system include:

- a higher efficiency rate and design flexibility;
- lower operating costs as no drying agent is required and the plant would not need to be shut down regularly for maintenance works;
- no waste produced during the drying process as no desiccants are used;
- reduced risk of an explosion.

The PSA system is therefore preferred over the non-regenerative dryer for its efficiency and lower operating costs. However, this system is also preferred as the absence of a desiccant has an environmental and safety advantage over the non-regenerative HP dryer.

5.4 NO GO ALTERNATIVE

It is mandatory to consider the "no-go" alternative as part of the EIA process. The "no-go" or "do nothing" option would entail maintaining the status quo. Although this option will not be explicitly assessed in the EIA Report, it should be noted that the assessment of all impacts is made relative to the existing environment viz. the status quo, and accordingly there is de facto consideration of the "no-go" option.

This alternative would mean that the site would remain as is, covered by disturbed grassland vegetation and abandoned buildings. The abandoned buildings on site have recently been vandalised with equipment and materials stolen. The lack of maintenance and activity on the site would result in greater security risks on the site and surroundings, with the property potentially depreciating in value.

Under this option there would be no change to the existing environmental and social conditions at the site. There would be no potential Project impacts such as the risk of an explosion or fire, atmospheric emissions, traffic impacts as a result of distribution activities, disturbance to fauna and flora from the clearance of the Project site. These potential negative impacts have been assessed in *Section 8* of this Draft EIR. There are no environmental fatal flaws that have been identified as part of this assessment, therefore all potential negative impacts can be mitigated or reduced.

The rationale behind the Project is that there is a potential off-site risk at Air Products existing Kempton Park and Pinetown facilities which can be mitigated by decommissioning these acetylene production facilities and establishing a new facility in a location which has a reduced off-site risk. If the Project does not go ahead, these off-site risks would still exist and possibly increase due to further development around these facilities, such as is the case with the new residential township development to the north of the Kempton Park facility.

There are a number of direct benefits associated with Project, these include employment opportunities and associated skills development. Approximately 10 to 12 employment opportunities would be created during the Project operations. This would contribute to reducing the unemployment rate in the Midvaal Local Municipality (18 percent). Furthermore, there would be skills development and training opportunities offered to all employees as part of the Project operations. These opportunities would facilitate higher learning amongst the project workforce.

In terms of the greater community benefits, Air Products has in place a Corporate Social Initiative (CSI) strategy which identifies and supports socio-economic development projects that benefit the communities that surround their facilities. In relation to the Project, Air Products are currently in discussion with the Japie Greyling Primary School, located in Daleside to provide funding (R11 000 per month) for a school feeding programme. A

Project fund of approximately R 70 000 per annum will be set up at project commencement for community development projects or initiatives.

In addition, a portion of the lime produced by the Project facility will be available to farmers or contractors for use on surrounding agricultural lands or for the development of local roads. This will assist local farmers or businesses in reducing production or operational costs.

This Project also meets the goals of the Sedibeng District Municipality Spatial Development Framework (2013), in terms of developing the R59 corridor into an economic and provincial corridor. Air Products is global company with a brand that is recognised as a leader in the industry, this Project would therefore have local economic development spin-offs by attracting other companies into the area.

Should the Project not proceed, the socio-economic benefits described above would not be realised. Furthermore, the full economic potential of this site would not be realised if not developed. For this reason, the No Project Alternative is not considered to be a viable alternative.

5.5 BASIS FOR SELECTION OF PREFERRED ALTERNATIVE

The site location on Stands 88 and 89 of Valley Settlements Agricultural Holdings is the preferred site for the Project due to the fact that all technical criteria were met, as listed in *Section 5.1*. In particular, the Project site provides for an adequate safety buffer, ensuring a reduced off-site risk to surrounding land-users, water and electrical services are available for the Project operation and the site was already zoned for industrial use. Furthermore, there were no significant environmental constraints identified on this site, ie there are no watercourses or drainage lines on or in close proximity to this site. This site was also chosen as the Project meets the development goals of the Sedibeng District Municipality in terms of growing the R59 corridor.

The preferred site layout (*Figure 5.2*) was chosen due to its natural gradient, which will be used to capture the site's surface water run-off for sustainable use in the production process. Furthermore this site layout positions the facility (ie acetone tank, generator, compressors and cylinder storage areas) more centrally on the site (ie away from Tilliet Road). This layout therefore restricts the risks associated with the acetone tank, within the boundaries of the site.

The regenerative HP dryer (PSA system) is the preferred technological alternative for use in the production process due to its efficiency and environmental and safety benefits (ie no waste and reduced risk of explosion) over the non-regenerative HP dryers. These benefits are directly linked to the PSA systems independence of a desiccant or drying agent.

The no-go alternative is not considered feasible due to the existing and increasing risks at the existing Air Products facilities which can only be mitigated by closing down the acetylene gas plants at these facilities and establishing a new acetylene gas manufacturing facility where the off-site risks are reduced. There are no environmental fatal flaws resulting from the Project, therefore all identified impacts can be mitigated or reduced. Furthermore, the socio-economic benefits of the Project including employment, skills development and local economic development would not be realised in this area, which has as its objective to grow into an economic hub.