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AIRPORT MASTER PLAN: LELYSTAD AIRPORT

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Preface

In the first year of the education Aviation Studies at the Hogeschool van Amsterdam (HvA) project group 2A1P has got an assignment from the Dutch government. Project group 2A1P must give an advice to the Dutch government, for dividing the flight capacities of the airports in the Netherlands. A new airport has to be created to solve the growing capacities of the air traffic movements.

This report must be done in a time of seven weeks. The maximum amount of words is 20.000, excluding the appendices. The advice for the Dutch government, with regard to the creation of a new airport, will be given in this report.

We want to thank Pieter van Langen for his support and feedback during this project.

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Summary

Air traffic is a constant growing factor in aviation. This is according to several research companies and aircraft manufacturers. A portion from this growth has also been brought to the Dutch air traffic. Unfortunately the Dutch air traffic cannot accommodate more aircraft, due to the lack of space. The solution has to require on whether there would have to expand an already existing airport or develop a new airport.

It turns out that the growth of the passengers and air traffic would increase with 4,3% per year until 2030. This capacity would involve the current capacity. The capacity of passengers and air traffic in 2030 would grow to over 103 million passengers and over 1.9 million air traffic movements. All of the existing airports have their own limitations for each subject.

Three different concept locations were investigated to ensure to proficiency of the solution. These locations were Staphorst, Doetinchem and Lelystad. From these locations two of which had to create a new airport (Staphorst and Doetinchem) and the other had to be expanded (Lelystad Airport). All the locations were investigated on the terrain, environment, sound, airspace, flight routes and accessibility. These locations were compared to each other and it turned out that expanding Lelystad Airport was the best solution for this problem.

The airport consists of a landside and an airside. The landside is the public area of the airport.
This has several premises that can be publically used. The terminal is the main area for which is used to guide passengers to their flights. Each terminal has eight gates and is open 24 hours a day. There would be new hangars placed on the landside. For the accessibility, an alternate road towards and from the airport terminals would have to be constructed.
The airside is the non-public area of the aircraft. This area is strictly only for operating the aircrafts. It consists of a runway, taxiway, apron area and several facilities. The new runway would have a length of 2.1 kilometers and a width of 45 meters. There would be eight new taxiways made of asphalt and the apron would be made of concrete.
This airport would be operable for low cost carriers like Corendon, EasyJet, Ryanair and Transavia. As for the financial aspects for this expansion it would come to an amount of 70.6 million euro. Lelystad Airport has an assignation that would expire in 2014. This would have to be renewed to start building the airport in 2015 and the runway in 2017, so it would be open in 2020. And there should begin researching on whether this should expand even more by 2024.

Introduction

According to several research firms and even aircraft manufacturers is the aviation the next fifteen years a very growing factor. The Dutch government wants to profit from the growing aviation. Unfortunately there is not enough space on the airports in the Netherlands. The Dutch government want advice about the building of a new airport or expanding an already existing airport.

The knowledge about the airports is necessary to find out what kind of airport there has to be build or expanded. First of all knowledge is needed about the real problem. What are in 2030 the total amount of passengers and how many people cannot fly because of the capacity problem. To answer the question, create of expand an airport, knowledge about the already existing airport is needed. Than the landside of an airport and the airside of an airport will be discussed. The creation of an airport is not with any consequence, there are strict rules in the “Wet Luchtvaart”. **(1)**

There is large difference between creating a new airport or expanding an already existing airport. To make this difficult decision three options are chosen and compared to each other. There will be looked at the terrain, environment, sound, airspace, flight routes and accessibility of Staphorst Airport, Lelystad Airport and Doetinchem Airport. These airport will be compared and can gather point on the six requirement. The Airport with the most points win and will be the solution to the capacity problem. **(2)**

Lelystad Airport is going to be the new national airport in the Netherlands. The terminal, hangars, accessibility and facilities are all part of the landside of the new airport. The airside of Lelystad airport will consist of a runway, taxiway and of course an apron area. There will be some complains about the airport and houses will have to be isolated. Also many low cost carriers will have to come to the airport, otherwise there will be no aircrafts on Lelystad Airport. Finally the cost of the whole process and the future plan will be shown. After that there is a conclusion which shows why Lelystad Airport is going to be the best new Airport in the Netherlands. **(3)**

The Dutch legislation and ICAO annex 14 are the main sources for this report.

After the three chapters are an abbreviation list and appendices added. The process report of project group 2A1P can be found in the last appendix of this report.

1 Airport basics

There are over 40.000 airports across the world. All these airports have the same structure and purpose. In the Netherlands there is one main airport: Schiphol Airport. Thereafter there are several other small airports. There is not enough space available in 2030 for all the passengers in these airports. A solution for this problem could be making a new airport or expand an already existing airport **(1.1)**.

An airport always consists of a landside **(1.2)** and an airside **(1.3)**. The landside of the airport is the area where no aircrafts operate. The most common places in the landside are the terminal, hangars and facilities. The airside of the airport is the area where the aircrafts operate. This is the area where aircrafts land and take-off. This is the area for loading and unloading of the passengers and cargo. Also the fuelling and parking of the aircrafts are in this area.

Not only on the ground but also the space in the air is in control of the airport. To control the airspace easily, each airspace has their own category where different kind of aircrafts is allowed **(1.4).** These classifications are controlled by the Air Traffic Control, the Air Traffic Control guide the aircrafts to their destination. All these areas have rules and have been approved according to law **(1.5)**. All the airports in the world must obey the guidelines of ICAO, but every country has their own rules within the ICAO. The "Wet Luchtvaart" describes the legislation with regard to the aircrafts and airports in the Netherlands.

1.1 Dutch flight capacity

The current airports do not have enough space and capacity for the growing passengers and air traffic. The only way to solve this problem is to look at the current capacities **(1.1.1)**. If the current capacities of the airports are checked, the expected capacities in 2030 will be discussed **(1.1.2)**. To define the problem for further use a conclusion has been given **(1.1.3)**.

1.1.1 Airport classifications and current capacities

There are many types of aircrafts and all these aircrafts can be divided into different aircraft categories: general aviation, commercial, military aircrafts, sailplanes, propeller aircrafts, sport aircrafts and business jets. Each aircraft is different in size and weight. These aircrafts are also divided into international, national and military sections. But not all types of aircraft may land on all the airports. There are four different types of airports In the Netherlands. The largest one is Schiphol Airport **(1.1.1.a)**. Airports like Rotterdam The Hague Airport, Eindhoven Airport and Maastricht Airport are national airports and have a good influence on the economy of the Netherlands **(1.1.1.b)**. The provinces are responsible for the smaller airports in the Netherlands, the regional airports **(1.1.1.c)**. This is followed by the military airports, which have their own rules and air routes **(1.1.1.d)**.

1.1.1.a Schiphol

Schiphol is the largest airport in the Netherlands and also the most important one for the Dutch economy. On a yearly basis Schiphol Airport got over a 49 million passengers and there were over 400.000 aircraft movements only in 2011. Schiphol is an important European airport, ranking as Europe's 4th busiest and the world's 12th busiest by total passenger traffic. Schiphol has six runways, the newest runway is the polderbaan. Schiphol is the main base for many airlines like Arkefly, Corendon, KLM, Martinair and Transavia. Many low cost carriers decide to move to smaller airports because of the large landing fees and the intense traffic on Schiphol Airport.

1.1.1.b National airports

Airports of national signification are airports that receive international flights and are economically important for the whole country. The national airports in the Netherlands are: Groningen Airport Eelde, Lelystad Airport, Maastricht-Aachen Airport, Eindhoven Airport and Rotterdam The Hague Airport.

These airports are very attractive for low cost carriers like Ryanair, because of the low landing fees and there is a lot less traffic than on Schiphol Airport. Eindhoven Airport is the largest of the national airports, with 2.6 million passengers in 2011 and over 20.000 aircraft movements. The amount of passengers of the national airports are given in **appendix I**. The flights of the national airports will not go outside Europe. These national airports have the potential to become the largest airports in the Netherlands, but if they will the airports would not be attractive to the low cost carriers.

1.1.1.c The regional airports

The provinces are responsible for the airports of regional significance. These airports receive virtually no international flights. The airports affect mainly the regional economy. In the Netherlands are ten airports of regional significance:

- Ameland
- Budel
- Drachten
- Hilversum
- Hoogeveen
- Midden-Zeeland
- Standskanaal/Onstewedde
- Seppe
- Teuge
- Texel

Every airport has its own facilities and its own specialties. Small airports are not just for travelling, there are many different things available like: skydiving, training flights, gliding and sightseeing. The complete list of airports with their facilities can be found in **appendix II**.

1.1.1.d Military airports

The remaining airports in the Netherlands are the military airports. These airports are under control of the ministry of defense. There are a couple of military airports that are also national airports. These airports are Den Helder de Kooy Airport and Eindhoven Airport. For citizen aviation the rules for a national airport are applied. For the military part of the airport the ministry of defense is responsible. Each airport has their own specialties. For example the F-16 aircrafts are placed at Leeuwarden Airport and transport airplanes are placed in Volkel Airport. A full list of specialties and airports can be found in **appendix III**.

1.1.2 Expected growth 2030

To make a good impression of the expected growth there are made some estimates. These estimates are used in the tables. It is very hard to assume what the amount of passengers or air traffic will be in eighteen years.

It is known that the growth for passengers and air traffic in Europe will be 4,3% per year till the year 2030. With this percentage the amount of passengers and air traffic for the year 2030 can be calibrated.

All Dutch airports can process 48.5 million **(1)** passengers per year for the year 2012 **(table 1)**. The growth for Europe will be 4.3% per year till the year 2030. With this percentage the total sum of pas-

sengers that all Dutch airports must be capable of handling in the year 2030 will be 103.6 million **(2)** passengers per year. To calculate the growth in air traffic the same principle apply. The total sum of air traffic for all the Dutch airports is 899.000 **(3)** per year for the year 2012. The 4.3% growth must also be used to calculate the air traffic growth for the year 2030. This will be 1.9 million **(4)** air traffic per year.

Airport	Amount of passengers per year	Amount of air traffic per year
Schiphol Airport	45.100.000	760.000
Rotterdam The Hague Airport	922.000	86.700
Eindhoven Airport	2.200.000	32.400
Maastricht Aachen Airport	226.000	18.860
Eelde Airport	122.000	2.000
Total in 2012	48.570.000 **(1)**	899.960 **(3)**
Total in 2030	103.630.037 **(2)**	1.920.175 **(4)**

Table 1, airport passenger capacities

In the year 2030 the airports will have limitations **(table 2)**. This means that a certain airport cannot handle more air traffic then stated. This will result that the air traffic in 2030 is more than the airports can handle. This means that the airports cannot handle the demand. The largest problem seems to be passengers. This is a larger problem than cargo because cargo will most likely be transported by other transportation methods in the future. These methods could be by ship or train. Passengers are less likely to change their transportation methods because flying is much faster than other transportation methods.

Airport	Amount of air traffic per year
Schiphol Airport	1.400.000
Rotterdam The Hague Airport	100.000
Eindhoven Airport	120.000
Maastricht Aachen Airport	40.240
Eelde Airport	4.267
Total	1.664.507

Table 2, airport limitations

1.1.3 Conclusion

Considering that the passenger and air traffic capacities are growing through the years the following conclusion can be made:

- The amount of passengers per year will double for the year 2030.
- The amount of air traffic per year will double for the year 2030.
- The airports in the Netherlands cannot cope with the demanded air traffic.
- The largest growth will be with passenger air traffic.
- To cope with the demanded air traffic a new airport must be created or an existing airport must be expanded.
- The solution must cope with a minimum amount of 75.000 air traffic movements.

To give a final advisory to the Dutch government first must be decided if a new airports can be created or if an existing airport can be expanded. Before this decision can be made a research has to be done about airport basics and airport law to gain the needed information.

1.2 Airport design: landside

A part of the airport consists of the landside. The landside can be defined as the public area of an airport, including the secured area. Aircrafts do not operate in this area. The terminal offers several facilities for the passengers and the personnel **(1.2.1)**. Thereafter the hangars give the possibility to storage or repair aircrafts **(1.2.2)**. Beside the terminal and the hangars consists the landside of several facilities **(1.2.3)**.

1.2.1 Terminal

An airport's terminal building consists of a secured and unsecured area. In the transit hall, which is the unsecured area, are information desks, airline ticket desks, tour operator desks and similar facilities located. When passengers transfer from the unsecured to the secured area at the customs, a boarding pass is required. This part of the terminal is an international level for which a passport is also required. It provides some extra facilities for the passengers, like catering establishments and tax free shopping. The number of terminal buildings depends on the size of the airport. Rotterdam The Hague Airport has for instance one terminal building.

1.2.2 Hangar

A hangar is a large space without any pillars to hold the roof. Without these pillars there is enough space to storage aircrafts. The length and the width of the hangar depend on what kinds of airplanes are meant to be stored. Most of the time the hangar is used to fulfill the maintenance checks of the aircraft. But in case of fewer parking spaces on the apron the hangar will also be used as parking place.

1.2.3 Facilities

In order to keep an airport safe and pleasant for its passengers and visitors facilities are necessary. The following landside facilities can be found on international and national airports, such as Rotterdam The Hague Airport.

1. Medical services
2. Security
3. Parking areas
4. Accessibility

Ad 1 Medical services
Medical services are not required at the airport. Therefore in the most airports, medical services are not applied. In case of an accident in the terminal or further in the airport the local ambulance or medical help will be called. The firefighters are trained to confer first aid till the medical help arrives.

Ad 2 Security
Security services for the safety of the passengers on the airport are required. The amount of people who need to be hired for security related jobs depends on the size of the airport. The security of Rotterdam The Hague Airport is currently controlled by the "Koninklijke Marechaussee". The "Koninklijke Marechaussee" is divided into departments like police force and security, investigation and information and border surveillance.

Ad 3 Parking areas
When passengers or visitors arrive by car a parking area near the airport is necessary. For the people who want to leave their car for a couple of hours the short-term parking area is necessary. For those who want their car stored on the airport during their journey a long-term parking area is necessary. Parking areas are not required but those areas are very beneficial for the passengers.

Ad 4 Accessibility
The accessibility contains no specific requirements in ICAO, but an easy accessible airport would be beneficial for the passengers and visitors. It is useful for an airport to have public transport nearby. Rotterdam The Hague Airport do not have train station located near them but they are accessible by bus or taxi. Therefore Rotterdam The Hague Airport is located near a highway.

1.3 Airport design: airside

An airport consists also of an airside. The airside can be defined as the non-public area of an airport where aircrafts are operating. Aircrafts are taking-off and landing on the runways of the airport **(1.3.1)**. Thereafter aircrafts can move on the taxiways to reach the runway or the apron area **(1.3.2)**. The apron area is used to park the aircraft, but there are also more facilities for the aircrafts on the apron **(1.3.3)**.

1.3.1 Runway

A runway is an area prepared for the take-off and landing of an airplane. The pavement types have influences for which aircraft types can land and take-off on the runways **(1.3.1.a)**. Thereafter the runway consists of different areas **(1.3.1.b)**. These areas have certain measurements **(1.3.1.c)**, markings **(1.3.1.d)** and lightings **(1.3.1.e)** to land and take-off the aircraft safely.

1.3.1.a Pavement

There are different kinds of pavements available for a runway. These types can be regrouped in non-reinforced and reinforced pavements. The only type of non-reinforced pavement is grass, the other pavements are reinforced. The pavement types which can be used on a runway are:

1. Non-reinforced grass
2. Reinforced grass
3. Asphalt
4. Rigid
5. Block pavement

Ad 1 Non-reinforced grass
This kind of pavement is only suitable for the lightest types of airplanes. Their suitability depends on a number of things, like season and flat area. Even though there has to be a good drainage system underneath the surface.

Ad 2 Reinforced grass
By this kind of pavement there are polymer fibers inserted in the grass. This will result in a three dimensional strength and stability of the grass pavement.

Ad 3 Asphalt
Nowadays asphalt is being used because it has several advantages. It is easier to construct, simpler and cheaper to repair. Asphalt has also no adding between different sections.

Ad 4 Rigid
Rigid plates have as advantage a higher bearing strength. A rigid plate has also a longer lifetime.

Ad 5 Block pavement
The advantages of block paving are that it also can be used in the winter, it can be used immediately after laying and the maintenance is very quick and easy.

1.3.1.b Area function

The runway can be used only for take-off (take-off runway), only for landing (landing runway) or for both take-off and landing (runway) **(figure 1)**. The stopway (SWY) **(1)** is to protect the runway for the jet blasts that are produced by the jet engines. It is not as thick as the rest of the runway so landing or taxing is not allowed. The stopway can also be used for extra runway length in case of an emergency situation. The clearway (CWY) **(2)** is a clear area surrounding the stopway. Then there are four types of distance measurements: Take-off Run Available (TORA) **(3)**, Take-off Distance Available (TODA) **(4)** and Accelerate Stop Distance Available (ASDA) **(5)** and Landing Distance Available (LDA) **(6)**. TORA is the distance that is available on a runway where the underground is suitable for take-off and landings. TODA is the distance of the TORA including the length of the clearway. ASDA is the distance of the TORA including the length of the stopway. The LDA is the total available runway length with a suitable underground.

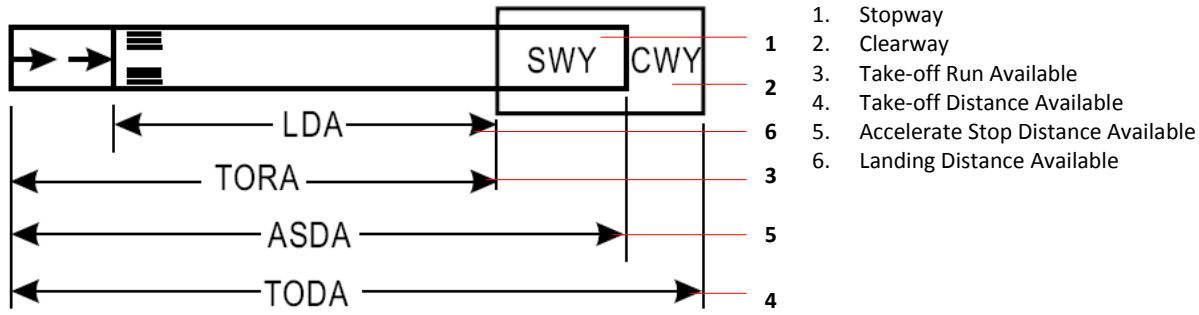


Figure 1, runway areas

1.3.1.c Measurements

There are different requirements for the measurements of a runway. These requirements depend on the aircraft size and weight. There are two types of grouping, one by the required field length (code number 1, 2, 3 and 4) and one by the wingspan (code letter A, B, C, D, E and F). Code number one implies that the field length is less than 800 meters, code number two implies 800 meters until 1200 meters, code number three implies 1200 meters until 1800 meters and code number four implies a field length longer than 1800 meters. Code letter A implies a wing span until 15 meters, code B between 15 and 24 meters, code C between 24 and 36 meters, code D between 36 and 52 meters, code E between 52 and 65 meters. Code number F implies a wingspan between 65 and 80 meters. These code numbers and letters can be used to determine the width of the runway. A review of these requirements for the runway measurements can be found in **appendix IV**.

1.3.1.d Markings

The markings of the runway **(figure 2)** give an indication for the pilots during take-off and landing. The beginning of the runway is marked with the threshold **(1)**. The pilots are only allowed to land after these markings. The number of threshold markings depends of the length of the runway. Behind the threshold markings there is a runway designation, which includes a number and if it is necessary a letter **(2)**. The runway which is sketched in **figure 2** has number nine, which indicates that

the runway is located at 90 degrees, referenced to the magnetic north. The letters which can be added to the runway are L, R and C. L indicates Left, R stands for Right and C references to Centre. Beside the threshold and the number and letter designation is also the touchdown zone **(3)** visualized. On the touchdown zone the aircraft can land safely. The centre line **(4)** and the aiming point **(5)** give the pilots a visual indication during take-off and landing. The centre line is positioned in the middle of the runway, which guide the pilots during the take-off and landing. The aiming point markings give a visual indication for the pilots during the landing.

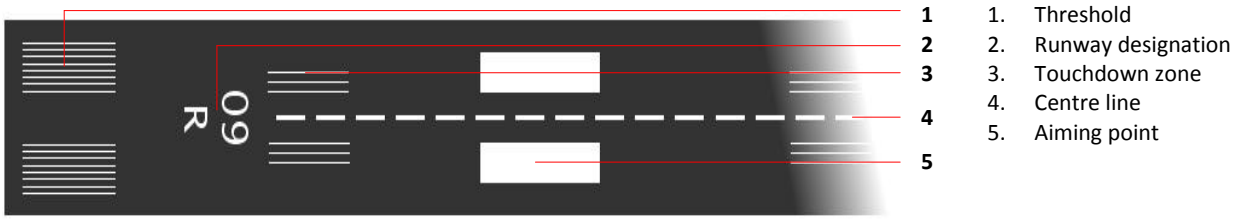


Figure 2, runway markings

1.3.1.e Lightings

The runway lighting **(figure 3)** give the pilots a better visual indication. It helps them to navigate safely when there are bad visual weather circumstances. There are different types of runway lighting, each having its own purpose. Most of the runway markings which have been discussed in **1.3.1.c** have also lighting with the same purpose as the markings. These are the runway threshold lighting (RTHL) **(1)**, the touchdown zone lighting **(2)** and the runway centre line lights (RCLL) **(3)**. On each side of the runway are also lights added, which are named as the runway edge lighting (REDL) **(4)**. These lights indicate the edge of the runway with the surrounding area. In front of the runway there are specific light located. At first there are the centre line barrette lights **(5)**, which indicate the centre line of the runway. Thereafter there are the side row barrette lights **(6)**. These lights have two functions, they inform the pilots that they have not passed the threshold and that they did not enter the touchdown zone. Finally there are the crossbar lights **(7)**, which indicate the pilots that they are approaching the runway in a horizontal position.

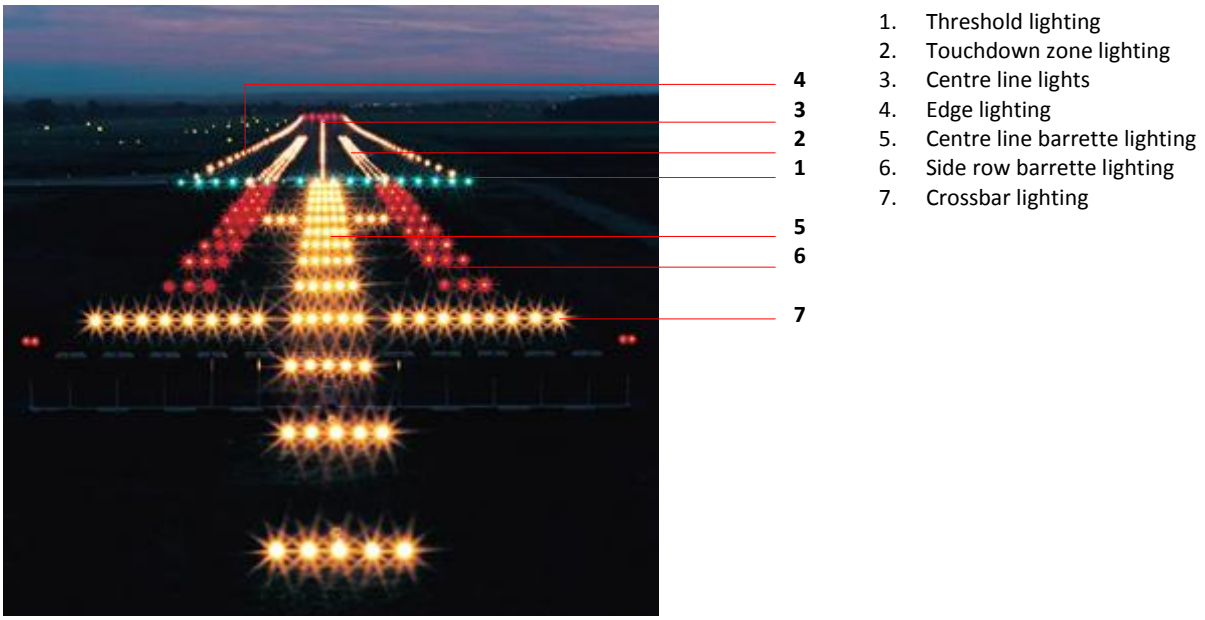


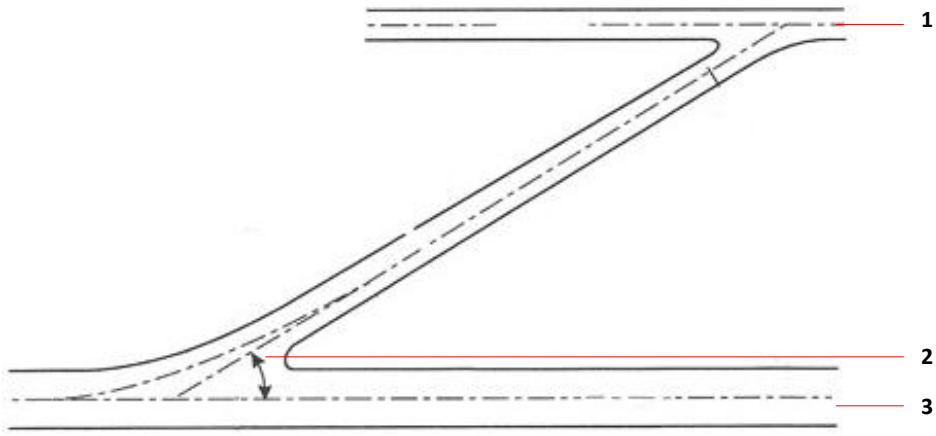
Figure 3, runway lighting

1.3.2 Taxiway

A taxiway is a part that connects the runway with the apron area. Its strength and surface has to be equal to that of the runway. There is a rapid exit taxiway other than regular taxiways. Its function is to allow aircrafts to exit the runway as quickly as possible. All taxiways have to be designed with certain dimensions **(1.3.2.a)**. Furthermore this part is designed with different types of markings, used for guidance **(1.3.2.b)**. For a better visual indication taxiway lights are used **(1.3.2.c)**.

1.3.2.a Dimensions

The taxiway width depends of the type of aircraft. This is categorized into code letters which are defined in a table in **appendix V**. All taxiways with code A aircrafts has to be 7.5 meters, code B aircrafts 10.5 meters, code C aircrafts 15 meters, code D aircrafts 18 meters, code E aircrafts 23 meters and code F aircrafts 25 meters. The rapid exit taxiway **(1)** has the same width dimensions as the regular taxiways, but the intersection **(2)** from it to the runway **(3)** should not be greater than 45° and less than 25°. The most preferred angle is 30°.



1. Taxiway
2. Intersection angle
3. Runway

Figure 4, taxiway dimensions

1.3.2.b Markings

There are different types of markings on a taxiway. The main one is the center line which is designed to ensure that the outer wheel of an aircraft does not surpass the taxiway width. It also guides all aircraft to the center line of the runway. This line is marked in yellow as well as the outer markers. These indicate the taxiway edge. Other taxiway markings are the runway holding and intermediate runway holding markings. All runway hold markings are divided into two patterns: pattern A and B. Pattern A is indicated with a line with a width of 1,05 meters and with even edge spaces of 0,9 meters. Pattern B markings are indicated with a width of 1,2 meters and centered spaces. The intermediate runway hold markings are indicated with dashed lines.

1.3.2.c Lightings

Taxiway lights have the ability to visualize all markings. All of these lights are controlled by the aerodrome control. The center line lights are mostly required to indicate the nearest and most available taxiway; these are indicated with a green light. The outer lights are to indicate the taxiway edges and are indicated in blue. These are separately placed alongside the taxiway.

1.3.3 Apron

An apron area is the area near the terminal, specifically for loading and unloading passengers, cargo, parking and fueling an aircraft. This areas surface has to be able to withstand more load than both the runway and taxiway due to the majority of aircrafts. And this area has also different markings. First of all is the yellow apron center line that is connected to parking areas, gates, taxiway center line. The isolated aircraft parking areas that are indicated with red lines. There is also a passengers path to ensure the passengers safety on the apron area. This path is marked with dashed white lines.

1.3.4 Facilities

The airside has several facilities. Facilities which serve for the safety for the passengers and the airplanes are mostly required by the law. The facilities which can be found at the airside are:

1. Fire protections
2. Bird control
3. Meteorological services

Ad 1 Fire protections
Fire protections are required at every airport, the size of the firefighting team depends on the size of the airport itself and the aircrafts that will land at the airport. Fire protections are divided in ten categories. In each category the firefighters needs to be 24 hours active. The category of the airport Rotterdam The Hague Airport is classified as category seven, which means that the airport can take care of an airplane with 39 meter as maximum length.

Ad 2 Bird control
Birds can cause a lot of damage to an aircraft during the take-off or landing, to prevent bird strike. A small team of people on the airport will apply the bird control. They make sure the birds would not stay on the runway and could not do any damage to the aircrafts. There are a lot of solutions to make sure birds are not going to sit down on the runway. Rotterdam The Hague Airport mostly use a loud sound in order to apply bird control.

Ad 3 Meteorological services
Meteorological services are required on the present airport. The airport needs to measure the temperature, the visibility and the wind speed themselves. These measurements are relevant for the use of the aircraft. A weather report for the passengers has no relevant information for the crew of the aircraft so a weather report is operable.

1.4 Airspace and navigation

The airspace has been structured in different categories **(1.4.1)**. This airspace classification will be controlled by the Air Traffic Control (ATC), depending on the type of flight rules which will be used by the aircrafts. The ATC will navigate the aircrafts through their flight routes to prevent collisions with other aircrafts **(1.4.2)**.

1.4.1 Airspace classification

The International Civil Aviation Organization has categorized the airspace in seven different classes, consisting of class A to class G. These classes make clear which aircrafts are allowed in these zones and which ATC is available. In the Netherlands are used six of these classes. A figure that contains these classes is sketched in **appendix VI**. The classes in the Netherlands can be divided in:

1. Class A
2. Class B

3. Class C
4. Class D
5. Class E
6. Class G

Ad 1 Class A
Class A of the airspace is situated between Flight Level (FL) 195 and FL 460. In this area are Instrument Flight Rules (IFR) flights allowed and Visual Flight Rules (VFR) flights prohibited. Radio contact with the ATC is required for the information. There is only access to class A by the clearance of the ATC. Thereby a transponder is also required for this flight class, which is a device that sends signals to the aircraft. These signals contain information about the course, speed and attitude of the aircraft. Above FL 460 is the air traffic uncontrolled and is it only accessible for IFR flights. Class A will be controlled by the Aerodrome Control and Area Control of the ATC. The Aerodrome Control, or Eurocontrol, controls the area above 24500 feet, which is about eight kilometers. Thereafter controls the Area Control Centre (ACC) the air traffic on a height of three to eight kilometers.

Ad 2 Class B
Class B is the controlled area of the airspace, where ATC and separation will be given. Just like in class A, clearance of the ATC and the use of a transponder is required. VFR flights are permitted in class B, but the sight must be minimal eight kilometers and it should not be cloudy. The ATC for class B consists of the Approach Control, including the Terminal Control Areas (TMA). The Approach Control controls the surrounding area with a distance of 60 to 100 kilometer from the airport and a height of about three kilometers and below. In the Netherlands are the TMA's Dutch Mil A, C, D and E above FL 065 and Maastricht TMA 1 and 2 above a FL 095.

Ad 3 Class C
Class C is also a controlled area of the airspace. This area is around airports. The distance can be from ten to fifteen nautical miles. The class C area is controlled by the tower, which will also take care of the separation. An aircraft can only fly in class C with approval from the tower. The maximum velocity in class C is 250 knots. VFR flight is allowed in class C but only if the viewing distance is greater than five kilometers.

Ad 4 Class D
Class D is also a controlled area and only occurs in one area in the Netherlands. This is north and south of Maastricht from FL 015 till FL 095. In class D VFR and IFR traffic is allowed, but approval from the ATC is a requirement. The ATC will handle the IFR traffic. The ATC will only give information for VFR traffic.

Ad 5 Class E
This class is also a controlled area. The lowest areas of the TMA's around the airports up to FL 065 are accessible for VFR and IFR air traffic. For IFR traffic is a clearance from the ATC a requirement and separation is only for IFR flights. There is no ATC for VFR flights, but there will be given advices for VFR traffic. VFR flights are only permitted when the visibility is free for eight kilometers, the horizontal distance to the clouds is 1500 meters and the vertical distance to the clouds is 300 meters. Large areas of the Netherlands with FL 055 to FL 065 are categorized in Dutch Mil.

Ad 6 Class G
Class G is an uncontrolled area with a height of 500 to 1500 feet. Around Schiphol Airport and Rotterdam The Hague Airport is the upper limit 3500 feet, but there are specific demands for these areas.

1.4.2 Navigation

The basic principles of navigation in the air includes the process of planning, recording the movements of the aircrafts and controlling the movements from one place to another. There are different techniques to navigate the aircrafts safely from one place to another. Which technique should be used depends on whether the aircraft is flying under the Visual Flight Rules (VFR) **(1.4.2.a)** or the Instrument Flight Rules (IFR) **(1.4.2.b)**. Aircrafts that travel at high speeds, leaving less time for calculating a new route and collisions are usually fatal for all passengers. Having a good navigation and constant awareness of positions are critical for the pilots. Thereafter is a good guidance for entering or leaving the airways required. This indicates that there must be Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs), which will be used for IFR operations **(1.4.2.c)**. When aircrafts are flying on the Instrument Flight Rules an Instrument Landing System (ILS) can be used to approach and land the aircrafts on the runway **(1.4.2.d)**.

1.4.2.a Visual Flight Rules

The first step of navigation is to make a flight plan **(appendix VII)** of the route. When flying under VFR circumstances the pilot has to consult an aeronautical chart. This map prominently shows the controlled airspace, radio navigation areas and airfields. It also shows hazards such as higher grounds, tall masts and towns, roads and woods as well. The job for the pilot is to make a safe track to follow, making sure to avoid the controlled airspace. In order to fly with the visual flight rules it is required for the pilot to have clear sight outside the cockpit to control its altitude, avoid obstacles and other aircrafts. The exact clarity in sight varies per jurisdiction and may also vary per airspace in which the aircraft is flying. Therefore the Visual Meteorological Conditions (VMC) should be consulted. If the VMC are not met, the flight may only operate under Instrument Flight Rules.

Aircrafts flying under Visual Flight Rules are required to have a transponder on board to communicate with the air traffic control and help them identifying the aircraft on radar. It is also possible to ask ATC for flight rules if workload permits it and clearances to land will always be given according IFR by the ATC. However, VFR is not allowed in flight zones known as class A areas.

1.4.2.b Instrument Flight Rules

When an aircraft is flying under instrument flight rules it basically follows a designed path from airport to airport. Those standard routes are shown in published charts. Those flight paths are actually highways in the sky and every route and point is given its own name, this way every pilot is able to create a route in a very structured manner. The positive side of planning a route by these standards is that every pilot declares its route to the ATC. The ATC is not allowed to give orders all the time because the pilot actually promised to fly its intended route.

Routes for lower flying aircraft are called vector ways, the routes flown by these aircraft usually go from point to point, which basically means they fly from beacon to beacon. Beacons are radio transmitters spread around the world. Beacons are each given its own name so it is clear and easy to communicate with the air traffic controllers and the ATC on their turn can give orders to the pilot to follow assigned beacons to get from A to B.

1.4.2.c SIDs and STARs

There are two different procedures and checkpoints that are used to enter or leave the different flight routes in the airspace. These are:

1. Standard Instrument Departures
2. Standard Terminal Arrival Routes

Ad 1 Standard Instrument Departures
Aircrafts flying under IFR follow a set path to get from one airport to another. But before the pilot is able to get to a flight route the aircraft should climb thousands of feet. Therefore the Standard Instrument Departures are invented. Standard Instrument Departures are actually smaller routes for aircrafts to follow to get from the runway to the first point of their flight route. ATCs are using these routes to guide the aircrafts away in a safe neat line, so even when it is very busy, the ATC knows that the pilots are all flying in one direction behind each other in one line. A SID route basically tells what beacon to fly to, how high to climb and when to make a turn to get to the set flight route.

Ad 2 Standard Terminal Arrival Routes
The Standard Terminal Arrival Routes are actually the opposite of the SIDs. Instead of leaving an airport by using a SID, the STAR should be consulted when approaching an airport. The Standard Terminal Arrival Routes for each airport are also shown in the published flight chart. By using a STAR, the pilot and the ATC know exactly what the intentions are and thus less communication is needed. At the end of the STAR, the aircraft should be in the position so the pilot can take the last orders from the ATC and get clearance to land the aircraft on the assigned runway.

1.4.2.d Instrument Landing System

The Instrument Landing System is used to approach and land the aircrafts. This system makes it possible to land with bad visibility conditions and it allows automatic landings. It can only be used with the IFR flights and consists of three independent systems, which are:

1. Localizer
2. Glide slope
3. Marker beacons

Ad 1 Localizer
The localizer gives the aircraft the lateral guidance straight towards the centre line of the runway and consists of several antennas. The signal from the localizer will be given by a Very High Frequency (VHF) radio transmitter, which is situated on the end of the runway.

Ad 2 Glide slope
When the aircraft has the correct speed, heading and altitude it can be guided towards the glide path. This system gives the aircraft a vertical guidance during the landing. The Ultra High Frequency (UHF) radio transmitter gives the signals to the aircraft. The glide slope transmitter is located at approximately 750 to 1250 feet from the threshold zone of the runway. The information of the localizer and the glide path will be displayed in the cockpit on the instrument panel.

Ad 3 Marker beacons
The marker beacons give the pilots an indication of the distance towards the runway. These indications will be given by a beam which one has a frequency of 75 MHz. There are three different marker beacons. These are the outer marker, the middle marker and the inner marker. The outer marker should be located at a distance of 7,2 kilometers from the runways threshold. This distance can have a deviation, because it may also be located on a distance of 6,5 to 11,1 kilometer. The middle marker is situated at a distance of approximately 3500 feet and the inner marker of 1000 feet from the threshold. The information of the marker beacons will be shown in the cockpit.

The Instrument Landing System is divided in three different categories. This division will be made by the decision altitude and the Runway Visible Range (RVR). The decision altitude is the height where the pilot has to confirm the landing. After a lower distance the pilot is required to land. The decision altitude depends on the RVR. The RVR is the distance where the runway has a good visibility for the

pilots. If the runway or the runway lighting is not visible, the landing must be interrupted. These distances are shown in **table 3.** Hereby is category three divided in three subcategories.

Category	Decision altitude [meter]	Runway Visible Range [meter]
Category 1	60 meter	550 meter
Category 2	60 to 30 meter	350 meter
Category 3A	30 meter and lower	200 meter
Category 3B	15 meter and lower	200 to 50 meter
Category 3C	No decision height	No Runway Visible Range

Table 3, ILS categories

1.5 Airport certification

The "Wet Luchtvaart" (WLV) will describe the legislation with regard to an airport for the Netherlands. According to the WLV an airport is not allowed to set a landing or take-off of aircrafts without an airport certification. Therefore an airport can receive this airport certification if it does not transgress and follow the following requirements. Extern safety risk, this contents the safety factor for the surrounding buildings **(1.5.1)**. The sound regulation takes a large priority within the running of an airport, the sound aspect must fulfill to strict requirements **(1.5.2)**. Planning is a valuable requirement and is fulfilled as the above statements do not disturb or bother the people, or damage buildings that stand or people who live around the airport, this also has to do with the flight safety **(1.5.3)**.

1.5.1 Extern safety risk

Extern safety risk content that the buildings, for example a house or company, cannot be around the extern safety risk area within a risk contour 10^{-5} of the risk factor of the middle line of a runway. So within this area all buildings will be extracted, except for the houses that are in use the day before the airport regulation has been given. New houses that will be built within six months cannot be extracted from their place. Between an area of a risk contour 10^{-6} and 10^{-5}, new buildings cannot be placed in this area and have to be taken aside. A new premise is approved to be built within these contours.

1.5.2 Sound regulation

Attached to the use of an airport there will be very strict rules about sound regulation. According to the WLV, the airport must maintain and respect noise regulations as L_{DEN} which stand for: Day-Evening- Night, as well natural day. These laws will be decided following the rapport of "Nationaal Lucht- en Ruimtevaartlaboratorium NLR-CR-2001-372".

The noise regulation from L_{DEN} is based on the noise around a natural day, so around the day, evening and night, the used noise factor of this measure is called LAX. This maintains the noise in dB(A) from each airplane for one second. Each dB(A) will be added to each other during one natural day, than the average will be taken over one year and the L_{DEN} arises. This resulting number must not transgress the sound threshold. The sound threshold is divided in three noise contours **(table 4)**. For each contour, 48 dB(A), 56 dB(A) and 70 dB(A), goes a different measure. This is because the airplanes do not equal damage at different distances.

Noise [dB(A)]	Measures
48	If the airport is ready for building there will be a consideration about the possible extensions of the airport and the buildings. Therefore a measure such as isolation the buildings could be applied, and can serve as solution.
56	New buildings of schools, hospitals and homes within this contour cannot be placed.
70	In this noise contour will schools, hospitals and homes be extracted from their places.

Table 4, noise contours

1.5.3 Planning

As a new building or planned structure will be created it has to comply with the development plan, this goes also for an airport. This development plan consists fixed rules for that specific area. The planning makes clear if the new airport will bother anything in its direct range. This is in case of the flight safety and the safety of the surroundings. If there is, the plan of the building of a new airport will not be put unless the airport company takes requested measures.

2 Location determination

To solve the capacity problem in 2030, shown in chapter one, many solutions are possible. The two most logical solutions are to create a new airport or to expand and already used airport. This new airport or expended airport should require the following requirements otherwise it is not realistic to create. The terrain, environment, sound, airspace, flight routes and accessibility all should be good and realistic by the creation or expansion of the airport **(2.1)**.

The first option is Staphorst Airport. Staphorst Airport would be a small airport for taking over the amount of passengers of the international and regional airports in the Netherlands. There is lots of space in this area of The Netherlands and there are enough roads and train rails that go from the airports to this place **(2.2)**.

The second option is a new airport Doetinchem Airport. The idea behind Doetinchem Airport is totally different from Staphorst Airport. Doetinchem is close near the German border, many passengers from Germany could travel from or to this new airport. This would be great for the Dutch economy and also take some passengers of the national and regional airports to solve the capacity problem **(2.3)**.

The third option is not to create a new airport, but is to expand Lelystad Airport. Lelystad Airport could be a business case airport, many business people from Schiphol Airport would land and take-off from Lelystad Airport. A smaller airport is a lot quicker for the business passengers to check-in and depart to their destination. Not only the business passengers but also the tourist for destinations in Europe would be a great income for Lelystad Airport. Lelystad Airport is very attractive for low-cost companies and could be the best solution for the capacity problem **(2.4)**.

All the three solutions are compared with the following requirements: terrain, environment, sound, airspace, flight routes and accessibility. The advantages and disadvantages are compared with each other and the best possible solution is the one with the lowest disadvantages **(2.5)**. Before starting to discuss the airport master plan a conclusion is of the advantages and disadvantages research will be made **(2.6)**.

2.1 Location solutions

At first the location requirements must be determined for a new or expanded airport **(2.1.1)**. When these issues are taken into account, the possible locations can be discussed. These options are to make a new airport, which are Staphorst Airport or Doetinchem Airport. Thereafter is it also possible to expand Lelystad Airport, that consist of General Aviation at the moment. It is also important to justify which options are not chosen, including Groningen Airport, Twente Airport, Eindhoven Airport and Rotterdam Airport. Creating or expanding a new airport must reduce the capacity problems for the other airports in the Netherlands **(2.1.2)**.

2.1.1 Location requirements

In order to find a new proper location for an airport to be build, the location should meet all the requirements as close as it gets. The new location for the airport should be favorable placed on the map of the Netherlands, its main goal is to relief other airports in the Netherlands from their pressure because the current capacity will be too high for the airports to handle. At first there must be enough space available **(2.1.1.a)** to build or expand an airport which can handle the capacities **(2.1.1.b)** for the year 2030. When this new airport will be build, the natural environment **(2.1.1.c)** and the noise aspects **(2.1.1.d)** must be taken into account.

2.1.1.a Space

First of all it is required to find a location in the Netherlands in which it is possible to even build a new airport with the necessary runway(s). There must be room for all the required facilities such as, (tax free) shopping center, secured parking lot, firefighters, security et cetera. Also there are different kind of runways, the airport that is planned to be build must be able to take away the pressure of other airports in the Netherlands so the runway(s) must be long and wide enough so it is safe to land any aircraft not larger than a Boeing 737. And it must be possible to expand in the future to create a new runway. Flight routes must also be taken in consideration when looking for a new location. The Dutch airspace is divided in military and civil airspace. It is better to avoid the military airspace. If the new possible location is situated in military airspace some solid agreements must be made in how flight routes can get planned without interfering with military aircraft. Also the existing flight routes should not be bothered too much by the existence of this new airport or expansion. Thus one of the main questions is: ”Is there enough space for a building plan of this size and would it not interfere with existing flight routes or military airspace?”.

2.1.1.b Capacity

The new location needs to be able to handle the required capacity now, and the expected required capacity when looking forward to 2030 as the air traffic will only continue to grow. For the Dutch economy it would be a smart decision to look forward and be prepared to handle even more air traffic in the future. When looking for a good location the total required capacity must be divided over the operating airports in the Netherlands. As expected the number of passengers travelling by aircraft in 2030 will be roughly 100.000.000. Therefore the possible location must have a good accessibility by train, bus and by car.

2.1.1.c Natural environment

When planning to build a new airport of this size to reduce the pressure on the other airports located in the Netherlands one important thing is the natural environment. As natural authorities are able to slow everything down or even cancel the whole building plan. There must be a real solid plan with everything covered. How is the bird population in the possible location? Are there any rare animal species living in the surrounded area? And how much of the natural habitat will get lost in the Dutch horizon? If any of those come up in one of the possible locations there must be a solid plan with great solutions so every party involved can accept the solutions such as moving a rare animal species to another location where no further harm will be caused. If there are many birds in the possible location there should be a bird control plan and if the natural habitat gets harmed there also needs to be a backup solution. The main question on this subject is: Will anything in the natural habitat get harmed with the building plan and if so, is there an alternative solution to solve this problem?

2.1.1.d Noise aspects

Besides the search for a good space that can handle the capacity and does not harm the natural habitat, the sound regulation is another very important aspect. The airport has to be assured not to exceed the given L_{DEN} quota which is active in the area. The possible locations must all meet the requirement to make air traffic even possible at the new airport. Not only now, but also in the future to keep up with the expected air traffic. In order to do this, the area surrounding the possible location should be screened for closely situated villages, cities, hospitals and schools. If any of those are close to the possible location and taking risk to be bothered by the noise in the future, measures must be taken. One of the measures is to completely isolate the building from the noise or in the worst case to completely move the building to another location.

2.1.2 Possible capacity solutions

Now that the requirements have been discussed, one can look at the different locations that can solve the capacity problem. There were three solutions to which could solve the capacities **(2.1.2.a)**. These solutions are further discussed later in this chapter. But there were also other locations, which have not been chosen. Most of them did not meet the requirements **(2.1.2.b)**.

2.1.2.a Adapted locations

There are many possible locations that can solve the capacity problem. Of all these solutions three are picked for further research:

1. Staphorst Airport
2. Doetinchem Airport
3. Lelystad Airport

Ad 1 Staphorst Airport

This new airport will be situated in the province Overijssel, because there is enough space available in this area. The runway of Staphorst Airport will be approximately 2200 meters, this will be large enough for a take-off and landing of a Boeing 737. This means that a great capacity of the other airports like Schiphol Airport, Rotterdam The Hague Airport and Eindhoven Airport will be reduced. There is a good possibility for improving the infrastructure between the airports, so the people can get fast and easy to their destination.

Ad 2 Doetinchem Airport

The expected passengers on Doetinchem Airport consist of businessman and tourist from Germany and other east-European countries. The city Doetinchem would be of more use as tourism comes. This will make Doetinchem a more touristic place. This would have great results for the Dutch economy. When the businessman use Doetinchem Airport for their travels, the capacity of the existing airport would lower and this would solve the capacity problems. The national train company will make a connection between Doetinchem and “Utrecht Centraal” which will make the airport more accessible.

Ad 3 Lelystad Airport

Lelystad Airport can be expanded to solve the capacity problems. Lelystad Airport could be a business case airport. This means that it will attract mostly business passengers. Business passengers will have smaller aircraft and will want to arrive and departure from their destinations quickly. Lelystad Airport can also be an airport for tourist traveling with low cost companies. If this is made possible then Schiphol airport can focus on bigger aircrafts. This will solve the capacity problem for Schiphol Airport. Lelystad Airport will also be an entertainment area. It will contain a big mall, this is not only pleasant for passengers but it can also stimulate the economy for the nearby areas.

2.1.2.b Non adapted locations

Beside these three locations there were also other choices that could have been made. These choices were all possibilities but each of them had one big disadvantage. The choices were:

1. Groningen Airport
2. Twente Airport
3. Eindhoven Airport
4. Rotterdam Airport

Ad 1 Groningen Airport
Groningen Airport was not chosen because it had a bad catchment area. It would take the passengers too long to travel from their home to the airport, which would not be cost effective.

Ad 2 Twente Airport
Twente Airport could not have been expanded because it lies within three big cities. Enschede, Hengelo and Oldenzaal. This means that further expansions would be hard to realize.

Ad 3 Eindhoven Airport
Eindhoven Airport was not a good solution because it is already full with low cost carriers and it was already expanding very rapidly. Boosting this expansion would be risky because it would make the start and landing prices bigger which might make Eindhoven airport less interesting for low cost carriers. Eventually they will find a cheaper airport to start and land, and the low cost carriers will move away from Eindhoven airport. This will make the expansion useless.

Ad 4 Rotterdam Airport
Rotterdam Airport has the same problem as Twente Airport. The room for expansion is too small. The expansion means an increase in air traffic and this increase in air traffic will give problems for the surroundings. More air traffic means more noise which would make the expansion impossible to achieve.

2.2 Staphorst Airport

The perfect airport can only by created if there is a perfect place for the airport. There are certain requirements for the airport. First of all the terrain of the airport has to be good. The surface has to be flat and there is no problem with the surrounding cities **(2.2.1)**. If the terrain of the place is good, the environment is a second priority. If there is any trouble with nearby nature, nature activist will protest against the construction of the airport **(2.2.2)**. Not only the nature activist can complain about building the airport, also many people who think the airport would make too much sound will complain about it, so the sound of the airport is also a priority **(2.2.3).** Furthermore the airspace classification for this location must comply with the requirement. **(2.2.4)**. There must also be a thriving connection between existing flight routes and the flight routes of this new airport **(2.2.5)**. Thereafter is the accessibility of the new airport an important factor for the passengers, because a good infrastructure is required **(2.2.6)**.

2.2.1 Terrain

Staphorst Airport is placed in the North-west of Staphorst **(1)** and the South-west of Meppel **(figure 5)**. The white line indicates the runway of Staphorst Airport **(2)**. This runway will have a length of 2100 meters and width of 45 meters. The area where Staphorst Airport can be build is approximately six kilometer width and four kilometers from north to south. Meppel is a city with 32.591 citizens, it is the smallest municipality in Drenthe. Staphorst is a village in the province Overijssel and consists of 10.000 citizens. At the moment the area, where the airport can be build, consists of pastures, two small water pools and approximately 100 households. This means that Staphorst Airport area is a sparsely populated area, but building an airport on this terrain will lead to consequences for these households. To create Staphorst Airport those houses will have to be taken down and the people will have to move out. There are several new house estates in the area of the province Overijssel, so there is a solution for these households.

1. Runway
2. Staphorst

Figure 5, terrain Staphorst Airport

2.2.2 Environment

Building Staphorst Airport does has not a beneficial effect for the environment. There are some environmental aspects which must be taken into account. These aspects are:

1. Nature areas
2. Bird areas

Ad 1 Nature areas

Near the location of Staphorst Airport there lies a nature park called “De Weerribben en Wieden”. In this nature park there are a couple of rare birds, like the Black Terns and Large Copper. This could be a real problem with the construction of Staphorst Airport. On the other side of the airport there is a small forest called “Boswachterij Staphorst”. This is a small forest with a lot of animals like deer, badgers, squirrels, owls and small snakes. It is also a relaxing area for a lot of people. In the middle of the forest there is a small lake called “De Zwarte Dennen”. This is a very touristic place in the summer for children and the elderly. Besides the small lake there are several moorlands and fens. There are various touristic routes with their own color code and length. The environment could be a big issue when building Staphorst Airport.

Ad 2 Bird areas

Not only the nature parks are very important. There are also some special bird areas. These are situated in stork stations around Meppel. These bird areas are not protected, but disturbing these areas is not very beneficial for the environment. The position of the stork stations should be taken into account when establishing the flight routes.

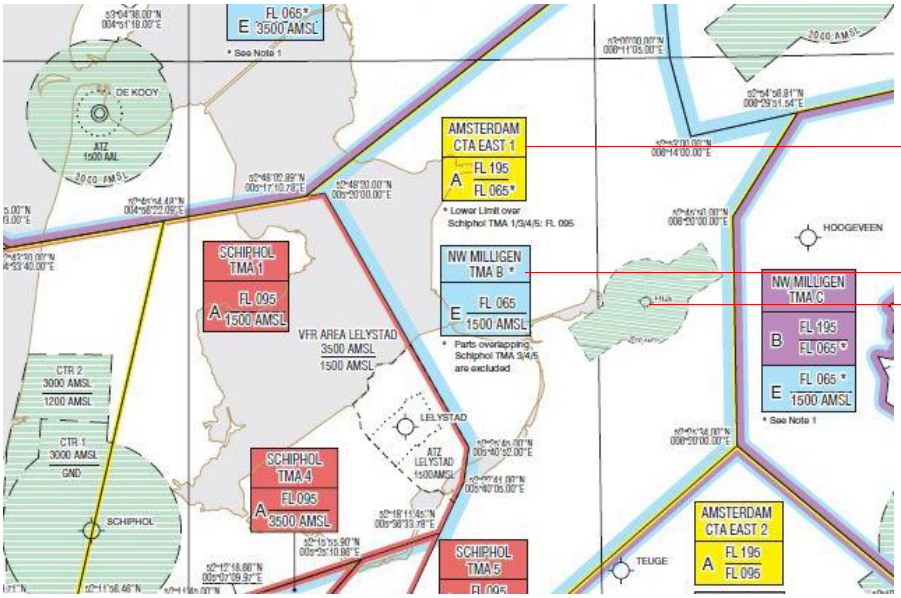
2.2.3 Sound

Each airport needs its own certificate from the Dutch government to control the maximum noise. If Staphorst Airport will be build to control a part of the capacities in the Netherlands, a new sound contour has to be created for this area. The sound contours depend on the environment, including the nature and bird areas, and the households that live nearby the new airport. The sound contours, which are discussed in **paragraph 1.5.2**, may not be exceeded. An indication of the sound contours for Staphorst Airport is sketched in **appendix VIII**. In this appendix there are three contours shown, these contours are for 20.000, 35.000 and 45.000 flight movements. The darker area which is shown

in the carts indicates the contour for 56 dB(A). The area which is sketched with a lighter color indicates the contour of 48 dB(A). These contours are made with other sound contours of other existing airports in the Netherlands and it is an assumption for Staphorst Airport.

2.2.4 Airspace

The location where Staphorst Airport can be build is not situated in the military flight zone, so there is a separation between the military and the normal air traffic. Thereafter there is also a classification for the flight zones at this new location **(figure 6)**. For Staphorst Airport the distance will be from 1500 feet up to FL 065 and will be controlled by Nieuw-Milligen (Nw Milligen) TMA B, which is a class E airspace **(1)**. From FL 065 to FL 195 the airspace will be controlled by Amsterdam CTA East 1, which is a class A airspace **(2)**. If Staphorst Airport will be build a new Control Zone (CTR) has to be created **(3)**. As sketched in this figure the CTR of Staphorst Airport will have a radius of approximately six miles.

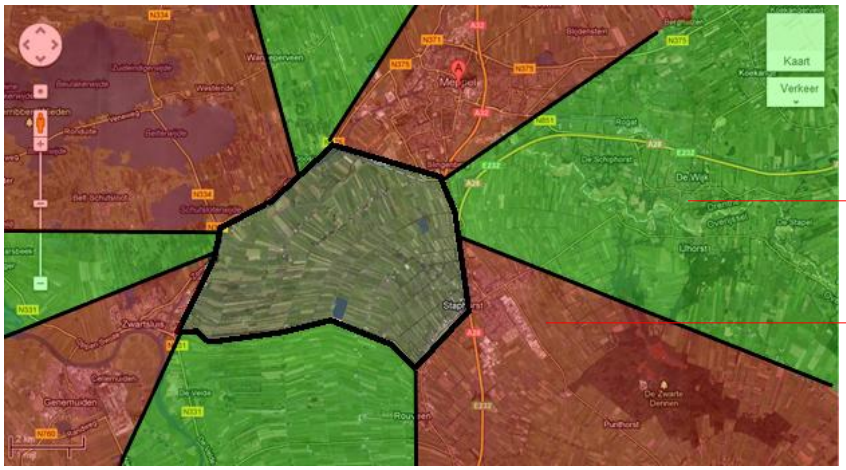


1. Nw Milligen TMA B
2. CTA East 1
3. CTR Staphorst Airport

Figure 6, airspace Staphorst Airport

2.2.5 Flight routes

The new runway of Staphorst Airport will be situated at 70 degrees of the magnetic north. Runway 07 has a good position with regard to the flight routes including the arrival and departure flight routes. When the available space around Staphorst Airport will be examined, the environment and the villages must be taken into account for determining the flight routes **(figure 7)**. In this figure there are red areas sketched **(1)**. These areas cannot be used for the flight routes. These areas cannot be used because there are nature areas and surrounding villages nearby. There are also green areas shown in this figure **(2)**. These give an indication for situating the flight routes to Staphorst Airport. A possibility for the flight routes of Staphorst Airport is to connect the new routes to Lelystad Airport.



1. Prohibited area
2. Accessible area

Figure 7, flight route spaces Staphorst Airport

2.2.6 Accessibility

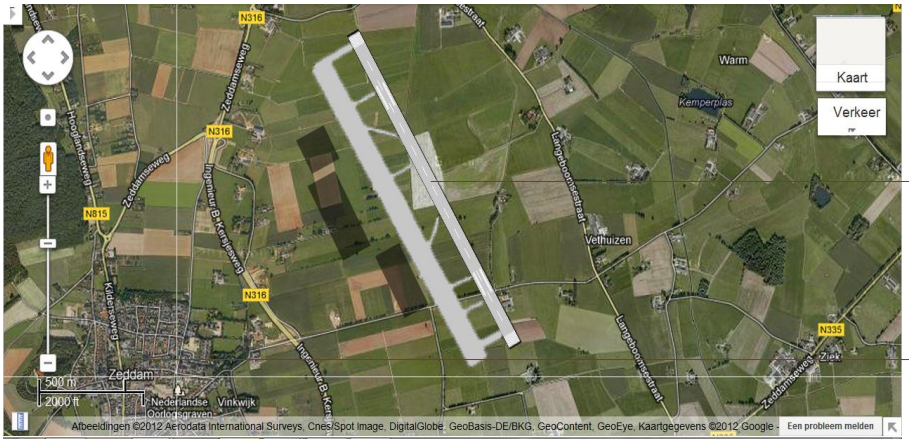
This location can be reached by several manners. Staphorst Airport is accessible by use of the highways, which are the A28 and N377. The location is situated next to highway A28 and it is surrounded by a few provincial and local roads. Furthermore it is also possible to travel to this location by train. Meppel, which is located above the location, has one railway station. This railway station has several train connections with other cities in the Netherlands. It also has a direct train connection to Schiphol Airport. When Staphorst Airport will be build, a good connection between Staphorst and Meppel is needed for passengers who travel with the public passenger transport services, like the railway station from Meppel. This connection can be made by use of shuttle busses. The accessibility for this location is good and can be made better by improving the public passenger transport services.

2.3 Doetinchem Airport

The second possible location will be called Doetinchem Airport. The airport lies southern of the city Doetinchem. Further there is a low population of people around the location of the airport **(2.3.1)**. The airport could cause not only the people problems but also the animals that live around the location. Therefore environment could be an issue **(2.3.2)**. Specific sound specifications need to be made to protect the people that live near the airport **(2.3.3)**. Doetinchem Airport will be a new airport and because it is a new airport a new airspace needs to be created. Therefore a part of an excising airspace needs to be modified **(2.3.4)**. Dutch flights routes are already decided. These are given on a map, according to law a new airport should follow these flight routes **(2.3.5)**. Above the airport a highway (A18) is located. This will be great for the accessibility of the airport **(2.3.6)**.

2.3.1 Terrain

Doetinchem Airport **(figure 8)** is located nearby Doetinchem, the airport lies 5.5 km southern from the city. Doetinchem is a big city and counted 57.000 civilians, therefore the airport lies a bit further from the city to prevent complaining from the civilians. There are several houses that lay in the area of Doetinchem Airport. These houses need to move to another soil in property of Doetinchem or Zeddam **(1)**. The length of the runway will be 2.1 kilometer long and the width will be 45 meters but these sizes could also be extended in the future **(2)**.



1. Runway
2. Zeddam

Figure 8, terrain Doetinchem Airport

2.3.2 Environment

Doetinchem Airport have to take into account with the environmental statements. Those statements are divided into two categories:

1. Nature areas
2. Bird areas

Ad 1 Nature areas

In the environment around Doetinchem Airport is one nature park located, this nature park is called "Stroombroek" and it is located 2.5 kilometers North of the location of the airport. An advantage of the airport is that the runway could avoid the direction in which Stroombroek is located. This means that the aircrafts do not approach right above Stroombroek. Though the sound contours could bother this quiet place.

Ad 2 Bird areas

The airport does not lie in a special breeding place for birds and does not contain any protected birds in its environment. But the birds that live or would stay near the waterside of Stroombroek could be a problem. They can cause bird strikes on aircrafts, but the bird control will be able to take care of it and prevent the birds coming nearby the airport.

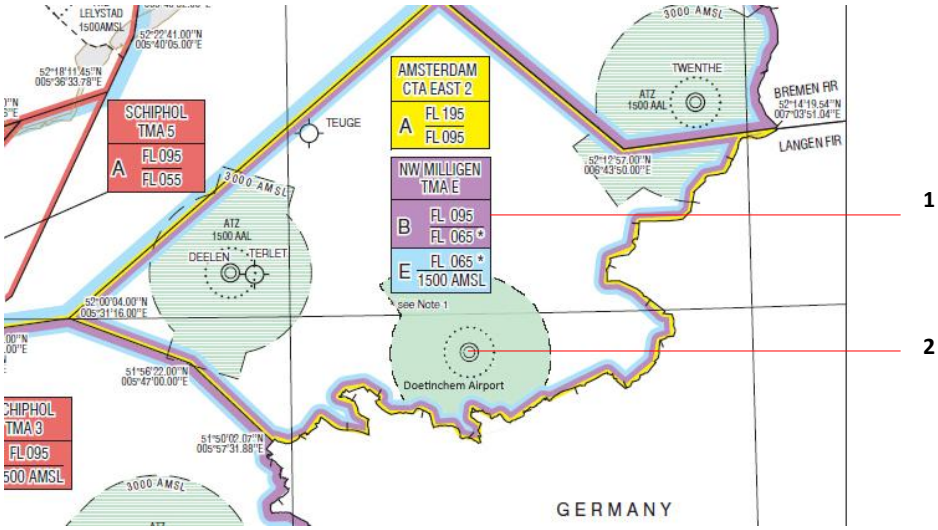
2.3.3 Sound

Because Doetinchem Airport will be a new airport and so noise contours can only be set by comparing the noise contours from other airports **appendix IX**. Zeddam lies about two kilometers Southwest from Doetinchem Airport, this means that Zeddam does not lay in the estimated 56 dB(A) noise contours of the airport. Nearby the airport there lay buildings in the noise contour of 56 db(A) these need to be isolated. There are also noise sensitive buildings around the airport, this means that there have to be measures taken to get those noise sensitive buildings protected. The indicated nature parks do not surpass those noise contours, this area is too far away from the airport. As long as the flight routes of the aircrafts do not surpass this area the airport does not have to take actions into account.

2.3.4 Airspace

The airspace of this location **(figure 9)** falls within the Amsterdam CTA east class A and the Nieuw-Milligen TMA class B and E airspace **(1)**. This shows that this location does not trespass military airspace. This airspace would have to be enhanced to develop a new CTR for the airport and could be

named to Doetinchem CTR **(2)**. This CTR will have a six mile radius. The airspace is controlled by the NW Milligen TMA E at 1500ft AMSL and FL 065. These altitudes are assigned to the airspace class E.

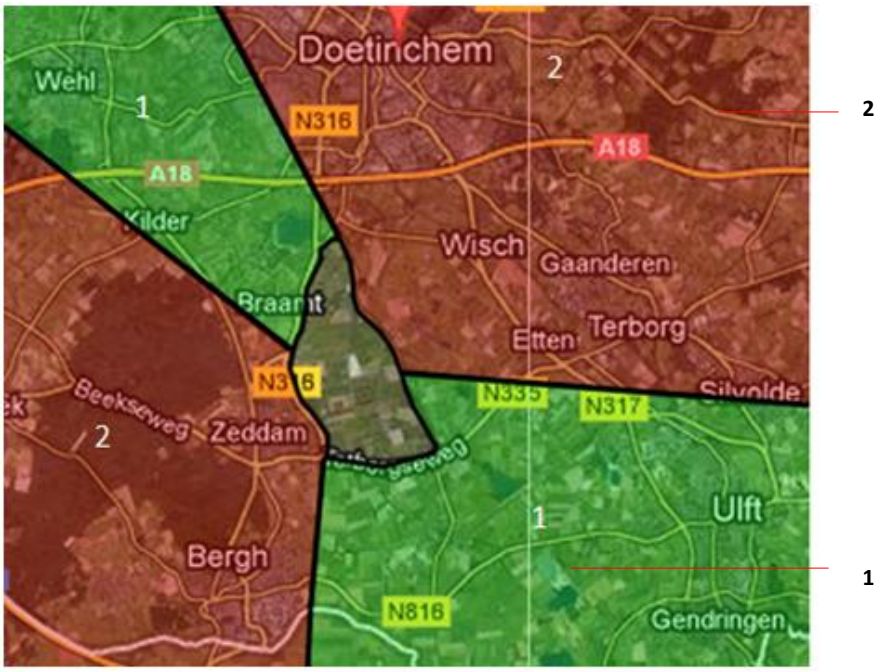


1. TMA West Milligen
2. CTR Doetinchem Airport

Figure 9, airspace Doetinchem Airport

2.3.5 Flight routes

Because this is a new airport it is required to develop new flight routes. These flight routes are depended on the runway direction, environmental areas and sound aspects. The previous named aspects are taken into consideration and the following is the result **figure 10**. Some flight route areas are allowed to fly through **(1)**. Other flight routes are prohibited on account of trespassing into military airspace, environmental area and sound limitations **(2)**. One of the military airspace is from Deelen Airport. This airspace is located a few miles West from the Doetinchem airspace. The North and North-east areas have a few nature areas. The airspace South-west of Doetinchem Airport is divided into civil and military airspace, which makes any flight towards this direction prohibited.



1. Accessible area
2. Prohibited area

Figure 10, flight route spaces Doetinchem Airport

2.3.6 Accessibility

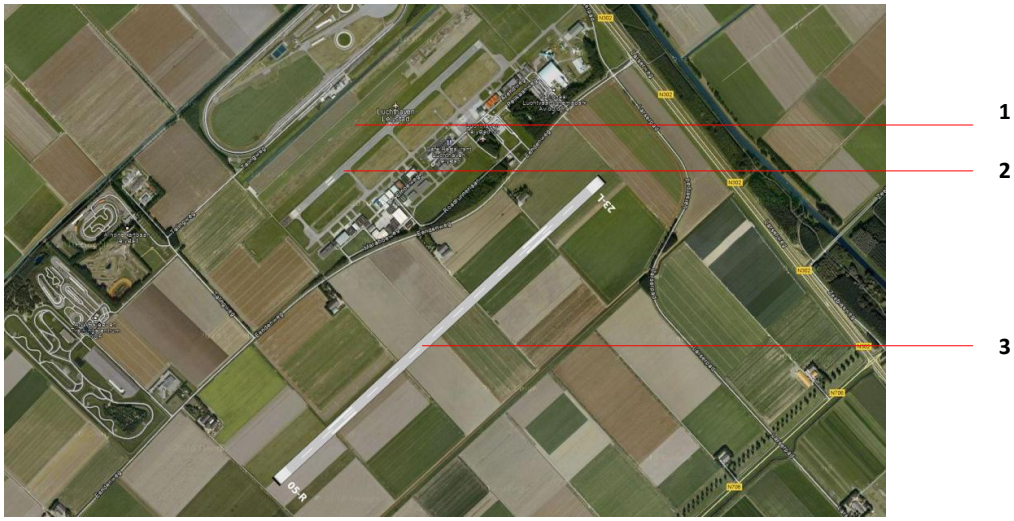
Doetinchem Airport is accessible by bus or car. The nearest bus traveling towards this location is bus 24 en route towards Heerenburg. For traveling by car it takes ten to twelve minutes. But for travelers from other cities it is necessary to take the A18 and take the N316 towards Zeddam. The nearest train station is at Doetinchem itself. These aspects give the Doetinchem Airport location a low accessibility rating. Because Doetinchem Airport lies near the German border it is quite accessible for German passengers.

2.4 Lelystad Airport

The third possible location is called Lelystad Airport. The airport lies in the centre of Flevoland nearby Lelystad city **(2.4.1)**. There will not only be looked at the human benefits, but the environmental will also be discussed **(2.4.2)**. Furthermore there will be looked at the specific sound that will be produced by the airport **(2.4.3)**. Then there will be looked at the possibilities in the airspace, this will be done by looking at the current airspace **(2.4.4)**. The available flight routes has to be adapted to the new situation **(2.4.5)**. The accessibility of the airport is an important factor so a good infrastructure is required **(2.4.6)**.

2.4.1 Terrain

Lelystad Airport is established in the province Flevoland **(figure 11)**. The airport is located under Lelystad city, this is a city with 75.317 citizens. Some houses are located closely to the airport and has to be expropriated. These could be located to a new neighborhood that will be build.
There are two runways available on Lelystad airport in the current situation. There is a small runway of 430 meters only for ultra light airplanes **(1)**. There is also a runway of 1250 meters which is paved and has a width of 30 meters **(2)**. This is runway 05. By building a new runway next to it, runway 05 will be named runway 05-L and the new runway will be named runway 05-R **(3)**. For the expansion runway 05-R will be extended till 2100 meter long and a width of 45 meters.



1. Small runway
2. Runway 05-L
3. Runway 05-R

Figure 11, terrain Lelystad Airport

2.4.2 Environment

Expanding Lelystad Airport has some disadvantages on the environment. The environmental aspect can be categorized in:

1. Nature areas
2. Bird areas

Ad 1 Nature areas

Larserbos and Knarbos-oost are forests nearby Lelystad Airport. Larserbos is a recreation forest where tourist can walk, cycle and go to the lake. Furthermore there are many kinds of birds living in this forest. On the other side is Knarbos-oost, this is a similar forest as Larserbos, and also has their rare birds. These nature areas can result in a problem for the expansion of the airport, the tourist can complain about the extra noise that will be produced. Also the environmental activist will complain due to the animals.

Ad 2 Bird areas

Besides the nature areas there are also special bird areas, there are two bird strike areas nearby Lelystad Airport, one in all seasons and one only in the winter. Further there could be many geese flying over. A few days a year this can result in increased risk.

2.4.3 Sound

Lelystad Airport already exists as an airport in the Netherlands therefore there already exist some sound contours. These sounds contours are given in **appendix X**. There are three sound contours given for Lelystad Airport, standing for 20.000 air traffic movements, 35.000 air traffic movements and for 45.000 air traffic movements during the year. There are two different color areas shown, this indicates the size of the intensity. The darkest colored area represents the 56dB(A) contour and the lighter colored area represents the 48 dB(A) contour. With this available data it will be easier to calculate the sound contours for the amount of air traffic movements that will eventually be made in a year.

2.4.4 Airspace

The airspace above Lelystad Airport is VFR AREA LELYSTAD. The upper limit is 3500 foot above mean sea level (AMSL) and the lower limit is 1500 foot AMSL. Lelystad Airport's TMA is Schiphol TMA 1. It is a class A area and the upper limit is FL 095 and the lower limit is 1500 foot AMSL.
Lelystad Airport would need a new TMA if it chooses to expand **(figure 12)**. This is because the traffic for Lelystad Airport would be too large for Schiphol TMA 1 to handle. LELYSTAD TMA 1 would be between SCHIPHOL TMA 1 and NW MILLIGEN TMA B **(1)**. LELYSTAD TMA 1 would be a class D airspace **(2)**. This makes it possible for IFR flights to land and it would also make it safe for VFR flights. The upper and lower limits would be the same as VFR AREA LELYSTAD.
Lelystad Airport would also have an own control area. This CTR will have a radius of 6 miles **(3)**.

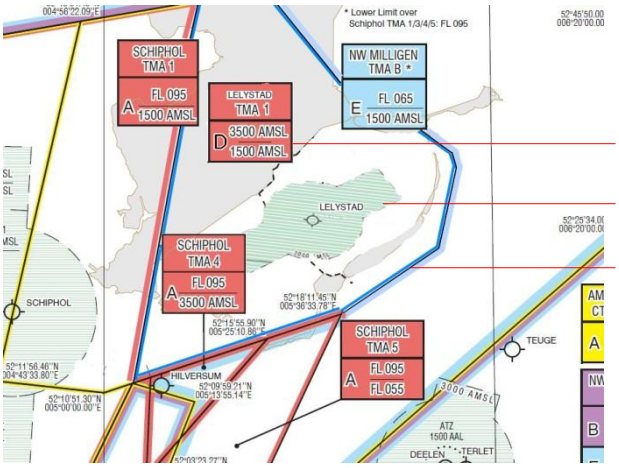


Figure 12, airspace Lelystad Airport

1. Lelystad TMA
2. Class D
3. Lelystad CTR

2.4.5 Flight routes

Runway 05-R at Lelystad airport needs new flight routes. The new runway will only support IFR flights. Runway 05-L will continue to support VFR flights. The VFR routes for runway 05-L will remain in operation. The NDB and NDB/DME routes for runway 05-1 will also remain in operation.
Runway 05-R will have an instrument landing system. This system is crucial to land bigger aircrafts. It also makes it possible to land aircrafts in bad weather, which is needed if Lelystad airport wants to be a business case airport.

2.4.6 Accessibility

Lelystad Airport does not have a good accessibility. There is only one highway running nearby Lelystad Airport which is the A6. It is crucial to better the accessibility if the expansion of Lelystad Airport is chosen. The only way to access Lelystad Airport in 2012 is by bus, taxi, rental car or a personal car. If passengers do not have the luxury to rent a car or take a taxi, which are quite expensive, they are forced to have a personal car. For most of the business people and tourists this is not the case.

The solution could be building a train station next to the airport. The train station makes it possible to reach the airport in a more comfortable, easy and faster way. The passengers would not need their personal cars and train tickets are much cheaper than renting a car or taking a taxi. This also means that much less parking area would be needed. Simple “Kiss and ride” areas would be enough.

The downside is that the railway for this solution must be made from scratch. There is already a railway running from Almere to Lelystad but this railway has just one lane. If building a second lane is too expensive it is also possible to build a railway from Lelystad to Lelystad Airport. This would make the travel process less fast as it would be with a direct connection from Almere to Lelystad Airport, but it would be cheaper and it can always be expanded in the future.

A second solution could be creating a shuttle service from Lelystad to Lelystad Airport. This shuttle service goes from Lelystad to Lelystad Airport, and vice versa, every fifteen minutes. This way the passengers can go from the airport to a nearby city, which has a well-functioning train station. Business people who can afford a taxi or a rental car will still be able to do so if needed.

2.5 Advantages and disadvantages

To make a decision which option will be chosen, the advantages and disadvantages for each location have to be determined. At first, the pros and cons for Staphorst Airport will be discussed **(2.5.1)**, followed by the advantages and disadvantages from Doetinchem Airport **(2.5.2)** and Lelystad Airport **(2.5.3)**. Finally an advantages and disadvantages table will lead to a conclusion **(2.5.4)**.

2.5.1 Advantages and disadvantages Staphorst Airport

The advantage of Staphorst Airport is that it has enough space surround the airport, but there are much households spread over the area. This will lead to consequences for those households. There is also a good possibility to connect the flight routes to the flight routes of Lelystad Airport. The accessibility of Staphorst Airport is also quite well. On the other hand are there a few nature areas surround Staphorst Airport. This is an unpleasant disadvantage for the airport, which has not a beneficial effect for Staphorst Airport. The sound contours can always have an effect for the household nearby the airport, but the contours give not a large problem.

2.5.2 Advantages and disadvantages Doetinchem Airport

Doetinchem Airport has not very much space in the surrounding area, but has like Staphorst Airport also households that live in the area where the airport can be build. The advantage, compared to Staphorst Airport, is that Doetinchem Airport has not much nature or bird areas nearby the airport. The accessibility for Doetinchem Airport is also quite well, but it has not a central position in the Netherlands. The airspace can be combined with existing flight routes. A disadvantage of Doetinchem Airport is that there are a few villages and cities around the airport, whereby annoyances with regard to the sound can occur.

2.5.3 Advantages and disadvantages Lelystad Airport

It is a good option to expand Lelystad Airport, because there is enough space available. An advantage compared to the other two options, is that Lelystad Airport has already their own flight routes. These flight routes can also be expanded. The sound contours are acceptable, but Lelystad Airport has two nature and bird areas nearby the airport. Thereafter has Lelystad Airport a good accessibility by car, but also by the public passenger transport services.

2.5.4 Advantages and disadvantages overview

Now the advantages and disadvantages have been discussed in the previous sub chapters, it can be summarized in an advantages and disadvantages overview **(table 5)**. Number one is the lowest score and number three is the highest score to achieve in this overview. The features which have been discussed for each location will be measured. Because not every feature is even important, there are made some weighting factors. The weighting factors have also a score of one, two or three. On the basis of the scoring and weighting factor follows a total score that includes all the features.

	Staphorst Airport				Doetinchem Airport				Lelystad Airport			
Feature	Score		Weighting factor	Subtotal	Score		Weighting factor	Subtotal	Score		Weighting factor	Subtotal
Terrain	2	·	2	= 4	1	·	2	= 2	2	·	2	= 4
Environment	1	·	3	= 3	2	·	3	= 6	2	·	3	= 6
Sound	2	·	3	= 6	1	·	3	= 3	2	·	3	= 6
Airspace	2	·	2	= 4	2	·	2	= 4	2	·	2	= 4
Flight routes	2	·	2	= 4	2	·	2	= 4	3	·	2	= 6
Accessibility	2	·	1	= 2	2	·	1	= 2	2	·	1	= 2
Total				23				21				28

Table 5, advantages and disadvantages overview

2.6 Conclusion

A location determination has been made in this chapter. Hereby are Staphorst Airport, Doetinchem Airport and Lelystad Airport researched. Lelystad Airport has the best total score in comparison with the other two airports. This means that the best solution for reducing the capacities of the other airports is to expand Lelystad Airport to a larger national airport. Lelystad Airport has to handle approximately 75.000 flight movements a year.

In the next chapter Lelystad Airport will be elaborated in more detail. The design of Lelystad Airport, including the landside and airside, the operations of the airport, the financial aspects and the implementation will be discussed.

3 Airport master plan: Lelystad Airport

Lelystad Airport is going to be the new national airport in the Netherlands. With a capacity of approximately 75.000 air movements a year and openings hours, with regard to the flight times, from 06:00 till 00:00 hour, this is going to be a great airport for low cost carriers. In the new terminal of Lelystad Airport there are schengen and non-schengen areas, whereby they offer only flights inside Europe. The accessibility of Lelystad Airport is more than good, there will be a new railway station on the airport. There is a highway close to the airport and there are also long-term and short-term parking areas. Lelystad Airport can also have plenty of facilities like rental cars, hotels and even an Aviodrome **(3.1)**.

The passengers are not the only factor that is important for the airport. The airlines and aircrafts are also of major importance. Airlines are mostly interested if the length and the width of the runway are long enough for their aircrafts to land. The airlines are also very interested in the taxiway and the apron area **(3.2)**.

The new runway of Lelystad Airport will be 05-R or 23-L. This way the aircrafts can land opposite of the wind. A problem of the 75.000 aircraft movements per year could be the sound that these aircrafts make. It will disturb the people living close to the airport, these houses will have to be isolated or expropriated. There are already many airlines interested in the new airport and they each have their own requirements **(3.3)**.

These new buildings, roads and railways are very expensive. The build of the runway, taxiway and the hangars is not cheap as well. But expanding Lelystad Airport is a lot cheaper than building a new airport on another location. Not only Lelystad Airport has to reckon with the space with the expansions of the airport. There also has to be enough space for another future expansion in the years after that, because the growth of the air traffic is not going to stop **(3.4)**. Finally the conclusion shows a summary of the expansion of Lelystad Airport **(3.5)**.

3.1 Landside Lelystad Airport

The landside of Lelystad Airport features all that is necessary for an airport of this size. As an airport decides to become a public airport, the terminal from Lelystad Airport has to be defined **(3.1.1)**. In the terminal passengers and visitors of the airport can find shops and relax facilities such as cafés, restaurants and further shops. The hangar is a facility for the airport itself **(3.1.2)**. In this hangar will be the maintenance checks of the aircrafts performed, the tenant or company that will use the hangar is not noted yet. If Lelystad Airport is going to solve the capacity problem, the accessibility of the airport is very important **(3.1.3)**. Therefore Lelystad Airport is accessible by personal car, rental car and public transport. After the build of the terminal and hangar, there will be enough space left. This space is reserved for other facilities **(3.1.4)** such as offices and hotels which may be necessary as facilities in the future.

3.1.1 Terminal

The new terminal will be build on the South side of the existing terminal of Lelystad Airport. The terminal of Lelystad Airport will have an operating time of 24 hours, whereby restaurants and shops are opened from 06:00 to 00:00 hour. Those passengers have to travel on an easy, comfortable and quick way, which can be achieved with the new build terminal. The terminal of Lelystad Airport consists of two zones. The first zone is a pre-security zone **(3.1.1.a)**. This zone is accessible for everyone and can be assumed as the public area of the airport. The other part of the terminal is the post security zone **(3.1.1.b)**. This zone is only accessible for the passengers who travel from Lelystad Airport.

3.1.1.a Pre-security zone

The pre-security zone consists of the transit hall and a part of the arrival hall. The transit hall offers several facilities for the passengers, but also for other visitors. In the transit hall there will be five airline tickets desks. For the travelers there are also other possibilities to check-in. This can be done with use of the self-service check-in kiosks, whereof ten kiosks will be present. This check-in philosophy will save time and it is easy and comfortable to use. Thereafter will be an information desk, a travel agency and tour operating ticket desks present at Lelystad Airport. To make this new airport attractive for the passengers and the visitors, it has to offer other facilities. For this reason the passage hall will be equipped with a shop and a catering facility. These facilities are opened during the daytime. It is also significant that there is a currency exchange window, a cash dispenser and there are toilets in the transit hall. It is also very useful that there is a meeting point for travelers and visitors. Al these provisions have to be present in the pre-security zone of Lelystad Airport.

3.1.1.b Post security zone

The pre-security zone will be separated from the post security zone by means of the customs. At the customs will be a passport control and a security check. After the passengers get through the security check, they will reach the departure hall. This hall consists of different facilities to make the waiting time comfortable. There will be departure lounges for the passengers in the departure hall. A large shop and a catering facility are also a requirement and toilets are also present in the departure hall. Thereafter passengers can pick up their luggage in the arrival hall. Furthermore the layout of the departure hall depends on the level of security. This can be divided into two different classes:

1. Schengen
2. Non-schengen

Ad 1 Schengen
The schengen area of the departure hall is accessible for the passengers who travel to countries that are located in Europe. It allows the passengers to travel to the EU-countries without restrictions. Not all the countries in Europe belong to the Schengen Agreement. A list and a map with the schengen countries can be found in **appendix XI**. The schengen area of Lelystad Airport will have four gates, whereby each gate has its own lounge room. For the 75.000 flight movements the gates can handle a reliable amount of passengers each year.

Ad 2 Non-schengen
The non-schengen area of Lelystad Airport is stricter with regard to security. Lelystad Airport will handle flights in Europe, so there are a few non-schengen countries. The non-schengen countries can also be found in **appendix XI**. This area will also have four gates, whereby each gate has its own departure lounge too.

3.1.2 Hangars

The hangars of Lelystad Airport will be rented to maintenance companies who do the actual maintenance checks of the aircrafts. The maintenance checks have to be fulfilled on a fixed amount of days, flights or flight hours. The hangar is not from any matter to the passengers but the airport simply offers this facility. Because the direct renter or maintenance company is not known yet, only the location on the airport and the dimensions are known yet. The whole fleet of Lelystad Airport does not and will not fit on the same time in the space the hangar is capable of.

3.1.3 Accessibility

The accessibility is very important for an airport, if an airport has a worthless accessibility the amount of passengers could reduce even for a new airport. Within the accessibility several solutions are contained. One solution is to construct better roads towards the airport **(3.1.3.a)** and there must also be a good connection with the highways **(3.1.3.b)**. An important factor for Lelystad Airport is that the passengers and visitors can travel by means of the public transport **(3.1.3.c)**. When the people travel to the airport by car, parking areas are also required **(3.1.3.d)**.

3.1.3.a Construction roads

Because Lelystad Airport is a general aviation airport at the moment, it does not have roads which are large enough to carry all the passengers in the future without creating traffic jams. This means that new or larger roads are necessary. The road that matters to the airport right now is called "Larserweg". This road makes the connection to the highway that runs through Flevoland, which is the A6. To make, out of this provincial road, a better accessibility to the airport, two extra lanes are necessary. One for the arrival and one for the departure from the airport.

3.1.3.b Connection highways

The connection to highway A6 from Lelystad Airport lies about 4,5 kilometers away from the airport. The A6 is connected to many other highways in the Netherlands, which will make the airport easily accessible by personal car. Further connections to a highway are not necessary for the accessibility of the airport.

3.1.3.c Connection public transport

Because Lelystad Airport will take a great part of the touristic passengers away from Schiphol Airport, a train connection is necessary to reach the train station Schiphol. The "Nederlandse Spoorwegen" (NS) already has a railway station in Lelystad Centrum with a direct connection towards Schiphol. The solution for Lelystad Airport for the accessibility is to build a new railway station on the airport. This train station will have a direct connection to Lelystad Centrum and passengers can reach Schiphol Airport without a transfer on station Lelystad Centrum. A bus will also make the accessibility much better from Lelystad towards Lelystad Airport. Because there will be an extra lane made on the road towards the airport, a bus will easily fit on the road without causing traffic jams. This bus will be financed by the government and will also serve as a public transfer. Shuttle buses are also an option to maintain the passenger capacities to and from Lelystad Airport. These shuttle buses can operate between, for instance, the railway station of Lelystad.

3.1.3.d Parking areas

Lelystad Airport is accessible by car, so each car needs a parking place. When the passengers are brought to the airport by other people, the passengers can be dropped of in front of the airport its entrance. This can be done at the special "kiss and ride" area. However, the parking area is an important facility for Lelystad Airport. The parking area will be divided into two different parking sections:

1. Long-term parking
2. Short-term parking

Ad 1 Long-term parking

The long-term parking area (P1) lies about five kilometers above the older runway. This is located nearby the highway to prevent traffic jams towards the airport. The passengers will be transported

by shuttle buses from this long-term parking area towards the airport. The extra lane in the road will be used as buss lane.

Ad 2 Short-term parking
The short-term parking area (P2) will be located closer to the airport. This parking lane will be located south of the terminal. The maximum parking time in this area is 24 hours.

3.1.4 Facilities

For the financial aspects of Lelystad Airport there are facilities necessary. Firstly a good facility for the passengers is a rental car **(3.1.4.a)**. For passengers, like business people, a hotel is a necessary facility **(3.1.4.b)**. Profit also has to be made. This can be done by means of an entertainment place, which already exist nearby Lelystad Airport and is named Aviodrome Lelystad **(3.1.4.c)**.

3.1.4.a Rental cars

To give the passengers and foreigners a choice of moving within the Dutch borders. A rental car facility will be established. The company, which name is not noted yet, will have rental car location near Schiphol Airport. Thus the passengers can move on their own to their destination. Besides handing in the car on Lelystad Airport the passengers could hand in their car as well on Schiphol Airport. The amount of days or hours one car can be rented will be variable and left to the concerned company.

3.1.4.b Hotels

For so far there is enough space available for extra facilities around Lelystad Airport. If lots of business people are travelling from and to Lelystad Airport, a hotel is a good option to make a profit. This option depends of the type of passengers and the accessibility from Lelystad Airport, but it is an option for the future.

3.1.4.c Aviodrome Lelystad

Aviodrome Lelystad is an aviation theme park nearby Lelystad Airport. Aviodrome is situated at approximately 200 meters from Lelystad Airport. It offers some entertainment for the passengers, visitors and foreigners, which is a good manner to make some profit.

3.2 Airside Lelystad Airport

The airside of Lelystad Airport represents all that is necessary to be able to fly on an airport. The aircraft has to take-off and land, therefore there has to be a runway **(3.2.1).** The runway has to be strong enough to handle all the large forces of a landing aircraft and also have to have all the required markings. The taxiway makes it possible for the aircraft to move between the runway, the gates and apron areas **(3.2.2).** The taxiway also needs to have all the required dimensions and markings. Because of expansion of the airport there now has to be an apron **(3.2.3).** Furthermore to make the airport safe and comfortable there are also several facilities on the airside of the airport **(3.2.4).**

3.2.1 Runway

The new runway will be 2100 meters long with a width of 45 meters. Knowing the measurements is just not enough to know how a runway has to be constructed. To construct a runway it is necessary to know what kind of aircrafts will take-off and land. By looking at the specifications of these aircrafts the runway strength **(3.2.1.a)** and navigation facilities **(3.2.1.b)** will be constructed.

3.2.1.a Runway strength

The runway strength depends on the weight of the aircraft and the number of wheels, this can be measured in the Aircraft Classification Number**.** The pavement classification number is a measurement for the pavement strength that is required**.** The PCN has to be larger than the ACN, which means that the strength of the pavement has to be larger than the maximal aircraft load. So the runway strength can be classified by:

1. Aircraft Classification Number
2. Pavement Classification Number

Ad 1 Aircraft Classification Number
The Aircraft Classification Number (ACN) is a number that stands for the structural loading effect of an aircraft on the pavement. The ACN number is formed with use of a formula. The maximum take-off weight is divided by the number of wheels, then times two. This number represents per ton.

Ad 2 Pavement Classification Number
The Pavement Classification Number (PCN) is a number that stands for the strength of a pavement. The PCN is the first number of a five-part code. For example: 40/F/A/W/T
40 stand for the PCN number. The “F” stands for the pavement type, F stands for flexible pavement and an “R” stands for rigid pavement. The “A” stands for the strength category, an A stands for High strength and a D stands for ultra low strength. The “W” stands for the maximal tire pressure, W stands for High/no limits, X is medium, Y is low, and Z is very low. The “T” says if all these numbers proven by technical evaluation. An “U” stands for aircraft experience.

Calculating the ACN for the Boeing 737 and the Airbus 320 result that it will not be larger than 45. A classification of these numbers from the Airbus A320 and the Boeing 737 can be found in **(appendix XII)**. This concludes that the PCN may be 45. Thinking in the future it might be an option to make the runway stronger than necessary, which make it possible to land larger aircraft in the future. Eindhoven Airport is a good example to compare with. If the new runway is just as strong as Eindhoven Airport then there are enough possibilities for in the future. This result in a strength code of: PCN 60/F/A/W/T

3.2.1.b Runway navigation facilities

To navigate the pilot safely to the runway there a several options, visual making use of the markings and lightings on the runway or instrumental by using an ILS.
The runway will be provided by all the marking that are explained in **1.3.1.d** and all the lighting is explained in **1.3.1.e**. Because this is the only runway available for this size of aircrafts it will be necessary to make markings and lightings on both sides off the runway. To make it possible to Take-off and land in both directions. To make it possible to land in bad weather conditions there will be used an ILS. The working of the ILS is explained in **1.4.2.d**. The ILS will also be placed on both sides of the runway.

3.2.2 Taxiway

A new runway would require new taxiways. These taxiways are going to have an asphalt surface to minimize any friction to the aircraft tires. There would be a total of eight taxiways. Two of these are rapid exit taxiways used in case of emergencies. Two other taxiways are placed on both ends of the runway. The last four taxiways are placed in between the rapid exit taxiways and the ends of the runway. This will ensure more efficiency for all circumstances. In reference to that the dimensions of these taxiways would be described **(3.2.2.a)**. All markings have to be also described **(3.2.2.b)**. And when all the markings are described the lightings could also be described **(3.2.2.c)**.

3.2.2.a Dimensions

The dimensions of the new taxiways are an important factor for this airport. With the dimensions it is meant towards the width and intersection angle. Each taxiway would have a width of 23 meters, which Is convenient for any commercial aircraft. These taxiways would also have a length of 2100 meters. The rapid exit taxiways would have an intersection angle of thirty degrees.

3.2.2.b Markings

The markings on the taxiways consist of the centerline and edge lines, these are marked in yellow. Each centerline is connected to the centerline of the runway and apron area. All the centerlines on the taxiways are marked 12.5 meters from the taxiway edges. The edge lines are marked exactly 20 centimeters within the taxiway edges.

3.2.2.c Lightings

All markings have to have lights according to the law. In reference to this analogy the edge markings of the taxiways would have blue lights planted exactly 20 centimeter beyond the taxiway edge. Almost every the centerline markings would be lit with yellow and green lights and are enabled for guidance towards and from the runway.

3.2.3 Apron

The apron area to the expansion of this airport is also required. Its surface is going to be made from concrete to withstand the maximum weight resistance. Its dimensions would consist of a width of 450 meters and length of 450 meters.

3.2.4 Facilities

Besides all the other airside attributes there are also several facilities. These facilities are the fire protections, bird control, meteorological services and anti/de-icing services. The fire protections and bird control services would be established near runway 05-R. The meteorological services are established near terminal one. Finally the anti/de-icing facility is established on the apron area holding area.

3.3 Operations Lelystad Airport

Now that the design aspect of Lelystad Airport have been discussed it is time to discuss the operation aspect of the airport. This means that there need to be looked at the flight routes that are going to be used by the new runway and how they affect the previous charts **(3.3.1)**. These flight routes also cause sound disturbance. This means that there are new sound contours that need to be calculated for the 75.000 flight movements that will occur on Lelystad Airport **(3.3.2)**. Another topic when looking at the operation aspect is which airlines will fly from and to Lelystad Airport and how can Lelystad Airport make it attractive for these airlines to actually come and fly from Lelystad Airport **(3.3.3)**.

3.3.1 Flight routes

Lelystad Airport will have a new runway, runway 05-R or 23-L, these runways will need new flight routes **(3.3.1.a)**. These flight routes will lay near the old flight routes for runway 05-L or 23-R so some of these need to be changed too **(3.3.1.b)**.

3.3.1.a Flight routes for runway 05-R and 23-L

There are certain charts that need to be made for runway 05-R and runway 23-L. Runway 05-R and runway 23-L use ILS as an approach so there need to be two ILS approach charts **(Appendix XIII)**. Both runways can use the same departure charts since there will be no interfering with one another. This is because most of the air traffic on runway 05-L and runway 23-R is with VFR.

3.3.1.b Flight routes for runway 05-L and 23-R

The arrival and departure flight routes for runway 05-L and runway 23-R do not need to be changed because they do not interfere with the flight routes from runway 05-R and runway 23-L. The VFR approach chart does interfere with the flight routes of runway 05-R and runway 23-L so there needs to be a new VFR approach chart **(appendix XIV)**.

3.3.2 Sound contours

The 75.000 air traffic movements in a year will have a certain sound disturbance for the nearby environment. How high this disturbance will be can be calculated with the gathered information **(appendix XV)**. The charts show that an increase from 20.000 to 45.000, which is more than a factor two, meant an increase of the contours with two kilometers. This means that if an increase of 45.000 air traffic movements to 90.000 movements, which is an increase with a factor two, will also cause an increase of the sounds contour with two kilometers. With this info a new sound contour chart can be made which will have higher sound contours than that Lelystad Airport would cause. It is better to use a contour that will be bigger than what Lelystad Airport will cause just to be sure that this contour will not be too small. The contour shows that Lelystad Airport will cause the most sound disturbance to the city of Dronten. It will not be necessary to isolate houses in Dronten. But to lower the disturbance for the citizens of Dronten it could be done. The number of houses that need to be isolated are around 50.

3.3.3 Operation airlines

Around the world there are hundreds of airlines. For the decision which airlines are the best for Lelystad Airport requirements are made. The Lelystad Airport is not an airport created for long distant flights, this leaves airlines like Singapore Airlines or Qatar Airlines. Lelystad Airport is a small national airport for 75.000 aircrafts movements per year. Lelystad Airport is very attractive for low-cost carriers because of fast access to the gates and an aircraft can easily turn-around in 20 minutes. Lelystad Airport can offer the airlines a highly professional airport with very attractive prices. The potential low-cost carriers for Lelystad Airport are: Corendon **(3.3.3.a)**, EasyJet **(3.3.3.b)**, Ryanair **(3.3.3.c)** and Transavia **(3.3.3.d)**.

3.3.3.a Corendon airlines

Corendon airlines is very interested in Lelystad Airport. Schiphol Airport is now the main basis of the airline but this can change if Lelystad Airport is going to expand to a larger airport. The only requirements that Corendon Airlines had before the expansion of Lelystad Airport where, the extension of the runway and longer opening hours. The new runway would be 2200 meters and the new openings hours are from 06:00 till 00:00. This would satisfy the requirements of Corendon Airlines.

3.3.3.b EasyJet

EasyJet is a low cost carrier of KLM/Airfrance. The main interest of EasyJet is a quick accessibility to the gates, fast check-in and security and a good measure of the luggage. The last requirement is that

there has to be a quick accessibility from the largest cities to Lelystad Airport. These requirement are easy to comply, fast check-in and security would be one of the main priorities of the new airport.

3.3.3.c Ryanair

Ryanair is the largest growing low cost carrier in Europe. Getting Ryanair to Lelystad Airport would be one of the most important tasks, and would be great for the Dutch economy. The requirements of Ryanair are, a turn-around time of 25 minutes, low costs and high population in the area. The Netherlands is one of the most populated areas in the world for the size of its country. The airport cost are not very large because Lelystad Airport is not going to be a large size airport. The turn-around time of the aircrafts on Lelystad Airport will approximately be 20 minutes. Lelystad Airport is a great option for Ryanair.

3.3.3.d Transavia

Transavia is a low cost carrier who has their main base on Schiphol Airport. Because of the economic crisis Transavia does not have enough money to stay on Schiphol Airport because of the high costs. Lelystad Airport is a great new opportunity for the main base of Transavia, because of the size of the airport and the low costs.

3.4 Economic aspects Lelystad Airport

Very important factors for building Lelystad Airport are the economic aspects. Namely, it is significant to know which factors increase the costs and what are the economic advantages. At first, the financial planning will be discussed **(3.4.1)**. The financial planning includes the airport costs and the financial prospects for Lelystad Airport. Thereafter will the implementation of this airport be discussed, where the planning from the current situation till the year 2030 will be determined **(3.4.2)**.

3.4.1 Financial planning

The financial planning consist of two aspects in matter to the Dutch government. The first aspect will be the airport costs **(3.4.1.a)**, this will consist the actual costs the airport will take with it. The second aspect of matter will be the Dutch financial prospects **(3.4.1.b)**. The built of the airport could ensure the creation of jobs to rise. This will have beneficial consequences for the Dutch economy.

3.4.1.a Airport costs

Before building the new airport there has to be done a lot of negotiate. Also these costs has to be taken into account for the creation of the airport. Then the required ground has to be bought and eventual the houses within the airport area has to be bought up. When all of this has been approved the construction of the airport can be started. The costs can be divided into:

1. Construction costs
2. Floating costs

Ad 1 Construction costs

The financial planning of the airport construction cost will consist of the components discussed in **subchapter 3.1** and **3.2**. Starting with the costs for the terminal these will result in a total of 23.2 million Euros. These cost are excluding the facilities such as stores and offices. To create a better accessibility the roads and highways have to be changed. These costs will result in a total of one million Euros. The creation of new parking areas will have a price of 3.4 million Euros and consist out 900 parking places. The new runway costs are formatted per square meter. The runway consist of 945.000 square meters, one square meter has a price of 150 Euros, this result in a total of 14.2 mil-

lion Euros. The taxi way costs 68 Euros per square meter, 483.000 square meters are required and result in a total of 3.3 million Euros. The apron area costs are 13.2 million Euross for 450 by 450 meters. Each square meter has a price of 65 Euros. To control all the aircraft from the ground there has to be an upgrade on the navigation facilities, these costs are based on the information given by expert of regional airports. The upgrade and support from the ground together result in a total of 5.8 million Euros. To make sure the budget is large enough a ten percent margin will be calculated to the total. This result in a total costs of 70.5 million Euros to create the new Lelystad airport.

Subject	Price in million [€]
Terminal	23.2
Infrastructure	1.0
Parking areas	3.4
Runway	14.2
Taxiway	3.3
Apron	13.2
10% margin	6.4
Total	70.5

Table 6, construction costs

Ad 2 Floating costs

Furthermore there are personnel costs like fire protection, these cost are 75.000 euro per fulltime-equivalent and there are 42 full-time equivalent required. This will end in a total amount of 3.15 million Euros per year. The costs of the air traffic control are 2 million euro per year. The yearly housing costs are 1.5 million Euros. The security costs are related to the passengers, these costs are 4,01 euro for each passenger movement.

Subject	Price [€]
Personnel costs	3.15 million
Traffic control	2.0 million
Housing costs	1.5 million
Security	4.,01 per passenger movement.

3.4.1.b Dutch financial prospects

When a new airport will be created or another building which needs a lot of money to spend on is build, a lot of jobs come to release. In time of many unemployed, the build of such a development could have positive consequences on the economy in different countries. The build of the new airport will cost the government a lot of money. During the build the government will have a lot of economical debts. To decrease the debts for the government investors could be searched. This could be some of the airlines and the Schiphol Group.

The consequences on the economy in the Netherlands will culminate in many job releases. At the moment in the Netherlands the unemployed numbers of people is relatively no little. So the creation of Lelystad Airport should help the labor market to restore. The terminal consist out of many shops whose needs a manager and employees. Further the airport needs employees in the facilities of the airport for both landside and airside.

These jobs will help the Dutch economy to restore. If the unemployed gets a job, they would not need a payment from the government, which will save costs. But apart from that, the former unemployed citizen will get more purchasing power, which means that the Dutch economy will get in a better state than before.

Besides the fact that Lelystad Airport will offer the society more jobs. The airport will handle the tourism in the capital city of the province Flevoland. The shopping facilities in the city will be more loaded cause of the tourists who want to relax and drink at the facilities, in the terminal as in the city Lelystad itself. The tourism of Amsterdam will not suffer in any form of the fact that the tourists are landing in Lelystad Airport. The airport is meant to be a flow factor for Schiphol Airport its tourists in Amsterdam.

3.4.2 Implementation

Now that the Airport Master Plan for Lelystad Airport is complete it is necessary to have a roadmap to 2030 **(appendix XVI)**. In this roadmap it is important to discuss the key dates for Lelystad Airport. If this is done the Airport Master plan can be handed to the Dutch government. There are six key dates which need to be discussed:

1. 2014: Current Lelystad Airport assignation expiration.
2. 2015: Start build new landside and airside facilities.
3. 2017: Start build runway 05-R / runway 23-L.
4. 2020: Opening new facilities and runway.
5. 2024: Start research “further expansion”.
6. 2030: Ending research “further expansion” including conclusion.

Ad 1 2014: Current Lelystad Airport assignation expiration.
Lelystad Airport has an assignation from the Dutch environment. This assignation will expire in the year 2014. To keep operating it is important for Lelystad Airport to get a new assignation before this date. This new assignation will maintain this airport master plan.

Ad 2 2015: Start build new landside and airside facilities.
If a new assignation is given for Lelystad Airport, the build can begin. The build will begin with the landside and airside facilities. These facilities can then be decorated and contracts can be made with airlines and shops.

Ad 3 2017: Start build runway-05-R / runway 23-L.
The only thing missing before the grand opening is the runway. The runway will be build the last to give the citizens, who might still be searching for a new home, longer time to find a home. This will hopefully reduce the number of complaints from the nearby citizens.

Ad 4 2020: Opening new facilities and runway.
The new facilities and the runway will now officially be opened. This must be a big event to start making Lelystad Airport a major airport in the Netherlands. This event must show the citizens and tourist what Lelystad Airport is and the comfort and pleasure Lelystad Airport can provide for its passengers.

Ad 5 2024: Start research “further expansion”.
Now that Lelystad Airport has been officially opened and it has been operating for four years it is important to keep looking forward. This means starting a new research that looks at the possibilities for further expansion. This will be a thorough research which will look at the occurring growth and the possibilities this growth gives. Maybe there will be a bigger growth than expected for the year 2030 and, if so, is further expansion of Lelystad Airport possible?

Ad 6 2030: Ending research “further expansion”.
In 2030 the research will be ended and a conclusion will be given. There can be two possibilities, the first is that Lelystad Airport has grown enough to maintain the growth of the air traffic. The other possibility is that the air traffic growth is too much for Lelystad Airport to handle. If Lelystad Airport

has grown enough then there will be no further action needed, but if the air traffic growth is too much for Lelystad Airport then there will be action needed.

3.5 Conclusion

In this chapter a researched has been made for Lelystad Airport. A determination has been made for the design and the consequences of the Airport.

Lelystad Airport will expand the current terminal building to a larger one. An expansion is required to handle the capacities, which are the 75.000 flight movements a year. Namely, Lelystad Airport will take over a part of the growing capacities from Schiphol Airport. The terminal building will offer several facilities for the passengers and visitors and will have eight gates. The landside is an important factor for the passengers, so it must be made pleasant. The accessibility of Lelystad Airport is also good, it can be reached by car or by means of the public passenger transport services.
The airside of Lelystad Airport will also be expanded by means of a runway with a distance of 2100 meters. This length allows Boeing 737 and Airbus A320 aircrafts. The runway will be indicated as runway 05-R and 23-L and will be equipped with an ILS on both sides of the runway. There must also be a connection from the runway to the apron area. This connection will be made by means of eight taxiways. Thereafter is the airside equipped with facilities like fire protections, bird control, meteorological services and anti/de-icing services. An airport plan of Lelystad Airport is shown in **appendix XVII**.

Lelystad Airport will be attractive for the low-cost airlines like Corendon, EasyJet, Ryanair and Transavia. The profit for these airlines is that Lelystad Airport offers an inexpensive price in comparison to Schiphol Airport.
Unfortunately there are very high costs for creating Lelystad Airport. The total costs results in 70.5 million euro for expanding this airport. But it will also have a beneficial effect for the Dutch economy, including an augmentation for the job releases.
Furthermore gives a roadmap an overview for the upcoming years. There must be given an assignation expiration for Lelystad Airport in 2014. When this is confirmed, there can be started with building the new land- and airside facilities in 2015. In 2017 there can be made a start with building runway 05-R / 23-L. After these buildings are completed, the new land- and airside facilities can be opened. The next years there must be done a further expansion till the year 2030.

Summarized can be said that Lelystad Airport is a great option for taking over the capacities from the other airports in the Netherlands. It will be beneficial for the Dutch economy and will reduce the burden for the upcoming years with regard to the growing capacities.

Abbreviation list

Abbreviation	Explanation
ACC	Area Control Centre
ACN	Aircraft Classification Number
AMSL	Above Mean Sea Level
ASDA	Accelerate Stop Distance Available
ATC	Air Traffic Control
CTA	Control Area
CTR	Control Zone
CWY	Clearway
FL	Flight Level
ICAO	International Civil Aviation Organization
IFR	Instrumental Flight Rules
ILS	Instrument Landing System
LDA	Landing Distance Available
MSL	Mean Sea Level
NS	Nederlandse Spoorwegen
PCN	Pavement Classification Number
REDL	Runway Edge Lighting
RCLL	Runway Centre Line Lights
RTHL	Runway Threshold Lightning
RVR	Runway Visible Range
SID	Standard Instrument Departure
STAR	Standard Terminal Arrival Route
SWY	Stopway
TMA	Terminal Control Area
TODA	Take-off Distance Available
TORA	Take-off Run Available
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
WLV	Wet Luchtvaart

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Appendices

I Passenger numbers

Year	Schiphol Airport	Eindhoven Airport	Rotterdam The Hague Airport	Maastricht Aachen Airport	Groningen Airport Eelden
2000	39.270.610	337.553	775.981		69.052
2001	39.309.441	282.233	826.889		59.501
2002	40.587.562	366.496	706.460		67.771
2003	39.808.649	422.735	726.287		54.942
2004	42.425.392	694.451	1.196.958		45.205
2005	44.077.539	946.218	1.098.300	356.000	47.265
2006	45.987.132	1.143.557	1.137.835	282.000	54.844
2007	47.794.994	1.544.098	1.146.692	160.000	59.406
2008	47.430.019	1.629.893	1.059.006	252.000	61.338
2009	43.570.370	1.739.053	991.390	135.696	65.545
2010	45.211.749	2.142.832	1.000.858	270.000	64.066
2011	49.755.749	2.650.000	1.158.420		

II Regional airports in the Netherlands

Vliegwiel Twente Maatschappij Amersfoort	An airport where can only be flown on the basis of an exemption.
Zeeland Airport Arnemuiden	An airport in Zeeland, which offers a variety of facilities for pilots and recreationists.
Vliegbasis Deelen Arnhem	A military airfield between Apeldoorn and Arnhem, in the museum are many photos and videos to see.
Ameland Airport Ballum Ballum	A small airfield used mainly for recreational purposes.
Seppe Airport Bosschenhoofd	Accessible for flight lessons and sightseeing.
Den Helder Den Helder	A regional airport and one of the largest offshore heliports of northwest Europe.
Eschede Airport Enschede	Airport for business and taxi flights, air charters and holiday facilities, free parking.
Vliegveld Twente Enschede	Current information about Airport Twente.
Vliegveld Hilversum Hilversum	Offer many activities on this airport, such as learning to fly, helicopter tours and photo flights.
Vliegveld Hoogeveen Hoogeveen	Many antique aircraft are displayed at this airport, the airport is situated on an industrial estate in the province of Drenthe.
Teuge Airport Teuge	An airport in the Dutch province of Gelderland, for domestic and international civil aviation
Texel Airport Texel	An airport located on a peninsula, one of the main activities is skydiving.

III Specialties military airports

Onderdelen van de Luchtstrijdkrachten			
Onderdeel	**Soort**	**Squadrons**	**Opmerking**
Hoofdkwartier Commando Luchtstrijdkrachten	Luchtmachtstaf	Eenheid kustwachtvliegtuigen Schiphol	Staf, administratieve en facilitaire diensten. Adres - HKCLSK / Lucht-machttoren, Lucht-machtplein 1, 4822 ZB Breda
Air Operations and Control Station Nieuw Milligen (AOCS NM)	Operationele commandovoering	711; 970	Vanaf 2009 tevens vre-deslocatie van luchtmo-biele NAVO-radareenheid DARS. Adres - AOCS NM, Amersfoortseweg 248, 3886 ZH Garderen
Luchtmachtbasis De Peel / Vliegbasis De Peel (GGW)	Joint Air Defense Cen-trum; Joint Air De-fense School	650; 800; 802; 803; 951; COLUA	Tevens zijn de CLAS luchtdoelartillerie (CO-LUA) eenheden hier ge-legerd en geïntegreerd in het JADC. Adres - GGW de Peel, Ripseweg 1, 5816 AC Vredepeel
Vliegbasis Deelen	Militair Luchtvaart Terrein	MLT Det.	Als vliegbasis gesloten in 1995. Dient als helikop-ter oefenterrein en is opstapplaats voor Luchtmobiele Brigade eenheden . Adres - MLT Deelen, Deelenseweg 1, Arnhem
Vliegbasis Eindhoven (VlbEHV)	Main Operating Base Luchttransport en hoofdkwartier NATO Movement Coördination Centre Europe (MCCE)	334; 336; 940; 941	336 Sqn vanaf 3 oktober 2007, uitgerust met 2 en vanaf 2009 met 4 C-130H Hercules. Adres - Vlb Eindhoven, Flight Forum 1550, 5600 RA Eindhoven
Vliegbasis Gilze-Rijen (VlbGZR)	Main Operating Base Helikopters	298; 299; 300; 301; 930; 931; 932	Defensie Helikopter Commando. Adres - Vlb Gilze-Rijen, Rijksweg 121, 5121 RD Rijen

Vliegbasis Leeuwarden (VlbLW)	Main Operating Base F-16	322; 323 (TACTES); 303 (SAR); 630; 920; 921; 922	Bestemming ongewijzigd. Het 303 (SAR) Squadron onder operationeel bevel DHC. Adres - Vlb Leeuwarden, Keegsdijk 7, 8900 JB Leeuwarden
Vliegbasis Volkel (VlbVKL)	Main Operating Base F-16	312; 313; 601; 640; 703 (USAF); 900; 901	Bestemming ongewijzigd. Adres - Vlb Volkel, Zeelandsedijk 10a, 5408 ZW Volkel
Vliegbasis Woensdrecht (KMSL Vlb WDT)	Opleidingen en logistiek	130; 131; 132; 133; 960; 961	Koninklijke Militaire School Luchtmacht Vliegbasis Woensdrecht (KMSL Vlb WDT), Luchtmacht Meteorologische Groep en Logistiek Centrum Woensdrecht (onderdeel van Defensie Materieel Organisatie). Adres - Vlb Woensdrecht, Kooiweg 40, 4630 SZ Hoogerheide
Vliegveld de Kooy (MVKK)	Maritime Support Helikopters	7; 860	Defensie Helikopter Commando.
Groep Luchtmachtreserve	Landelijke luchtmacht reservisten	sinds november 2004 met 1 Staf GLR en 5 squadrons; 600 het ondersteunings en opleidings squadron en 601-604 bewakings- en beveiligingsquadron. Verdeeld over heel Nederland.	
Vliegveiligheids Oefen Test Centrum (VOTC)	Training vliegend personeel		Ondergebracht op Vlb Gzry
Luchtmacht Meteorologische Groep (LMG)	Luchtmacht weercentrale		Ondergebracht op Vlb Wdt
Centrum voor Mens en Luchtvaart (CML)	Keuringsinstantie en kenniscentrum		Vanaf 2002 gevestigd te Soesterberg

IV Runway measurements

In the schedule which one is sketched below are the code letters for the wing span defined.

Code number	Code letter A	B	C	D	E	F
1[a]	*18 m*	*18 m*	*23 m*	–	–	–
2[a]	*23 m*	*23 m*	*30 m*	–	–	–
3	*30 m*	*30 m*	*30 m*	*45 m*	–	–
4	–	–	*45 m*	*45 m*	*45 m*	*60 m*

In the schedule which one is sketched below are the code numbers for the runway length defined.

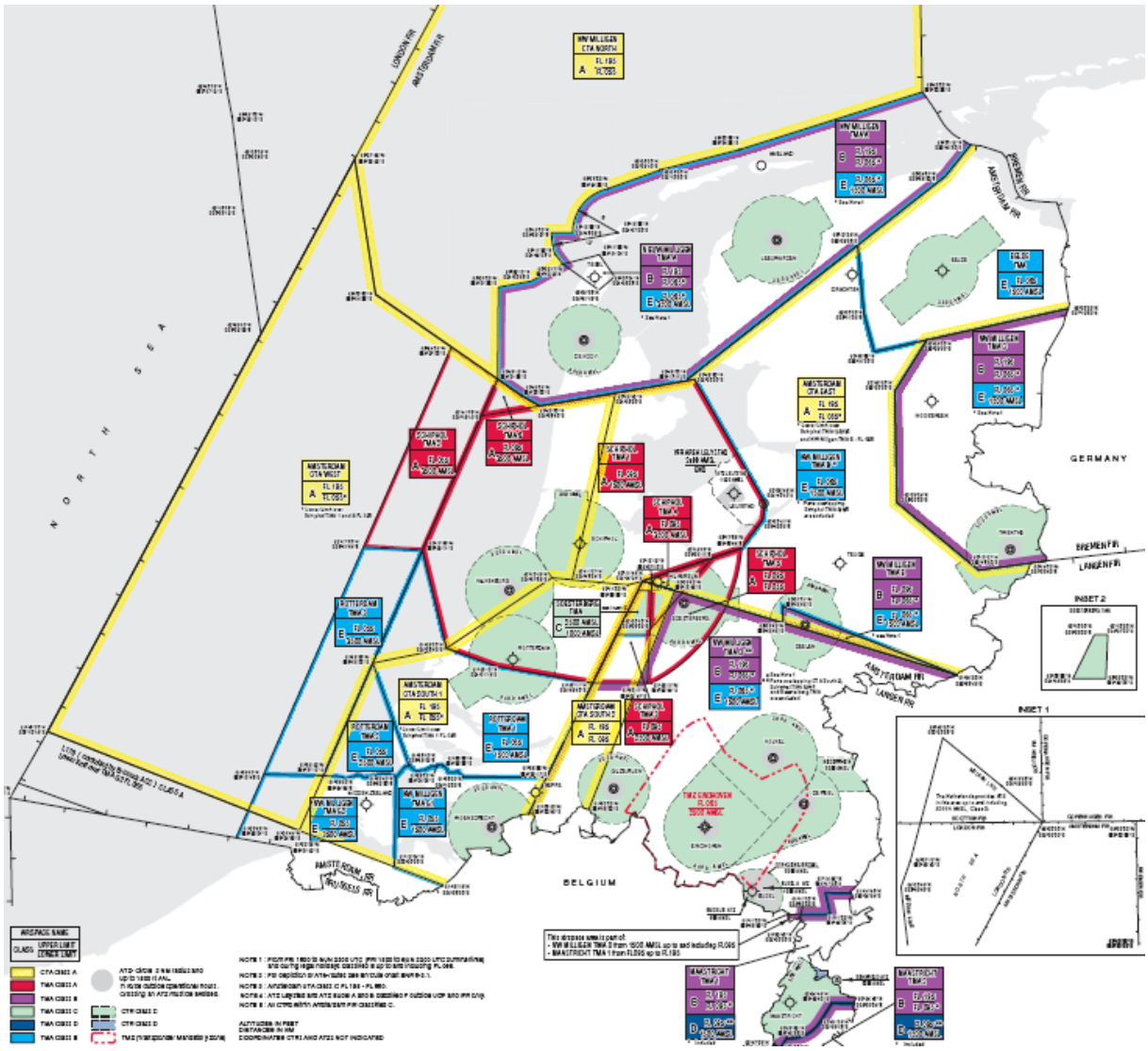
Code element 1		Code element 2		
Code number (1)	Aeroplane reference field length (2)	Code letter (3)	Wing span (4)	Outer main gear wheel span[a] (5)
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m

a. Distance between the outside edges of the main gear wheels.

V Taxiway width table

Code letter	Taxiway width
A	*7.5 m*
B	*10.5 m*
C	*15 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m;* *18 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.*
D	*18 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span of less than 9 m;* *23 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span equal to or greater than 9 m.*
E	*23 m*
F	*25 m*

VI Airspace classes the Netherlands



AIRSPACE NAME
CLASS UPPER LIMIT / LOWER LIMIT

CTA Class A
TMA Class A
TMA Class B
TMA Class C
TMA Class D
TMA Class E

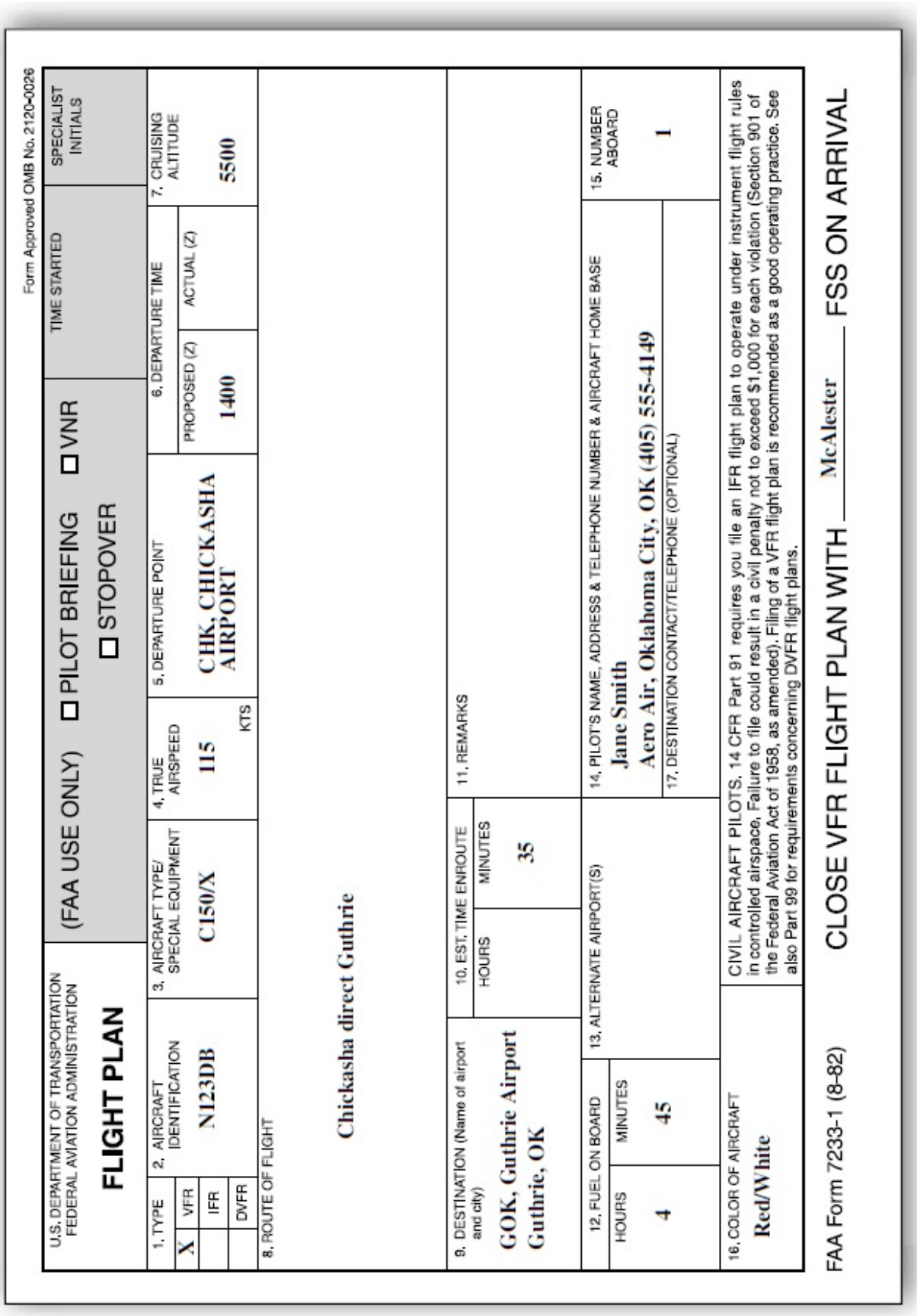
ATZ- Circle 2 NM radius and up to 1500 ft AAL.
In force outside operational hours.
Crossing an ATZ must be avoided.

CTR Class C
CTR Class D
TMZ (Transponder Mandatory Zone)

NOTE 1 : From FRI 1600 to SUN 2300 UTC (FRI 1500 to SUN 2200 UTC summertime) and during legal holidays classified E up to and including FL 095.
NOTE 2 : For depiction of ATS-routes see Enroute chart ENR 6-3.1.
NOTE 3 : Amsterdam UTA Class C FL 195 - FL 660.
NOTE 4 : ATZ Lelystad and ATZ Budel A and B classified F outside UDP and IFR only.
NOTE 5 : All CTRs within Amsterdam FIR Classified C.

ALTITUDES IN FEET
DISTANCES IN NM
COORDINATES CTRs AND ATZs NOT INDICATED

VII VFR flight plan



Form Approved OMB No. 2120-0026

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

FLIGHT PLAN

(FAA USE ONLY) ☐ PILOT BRIEFING ☐ VNR ☐ STOPOVER

TIME STARTED

SPECIALIST INITIALS

1. TYPE		2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE/ SPECIAL EQUIPMENT	4. TRUE AIRSPEED	5. DEPARTURE POINT	6. DEPARTURE TIME		7. CRUISING ALTITUDE
	VFR					PROPOSED (Z)	ACTUAL (Z)	
X	IFR	N123DB	C150/X	115 KTS	CHK, CHICKASHA AIRPORT	1400		5500
	DVFR							

8. ROUTE OF FLIGHT

Chickasha direct Guthrie

9. DESTINATION (Name of airport and city)	10. EST. TIME ENROUTE		11. REMARKS
	HOURS	MINUTES	
GOK, Guthrie Airport Guthrie, OK		35	

12. FUEL ON BOARD		13. ALTERNATE AIRPORT(S)	14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE	15. NUMBER ABOARD
HOURS	MINUTES			
4	45		Jane Smith Aero Air, Oklahoma City, OK (405) 555-4149 17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)	1

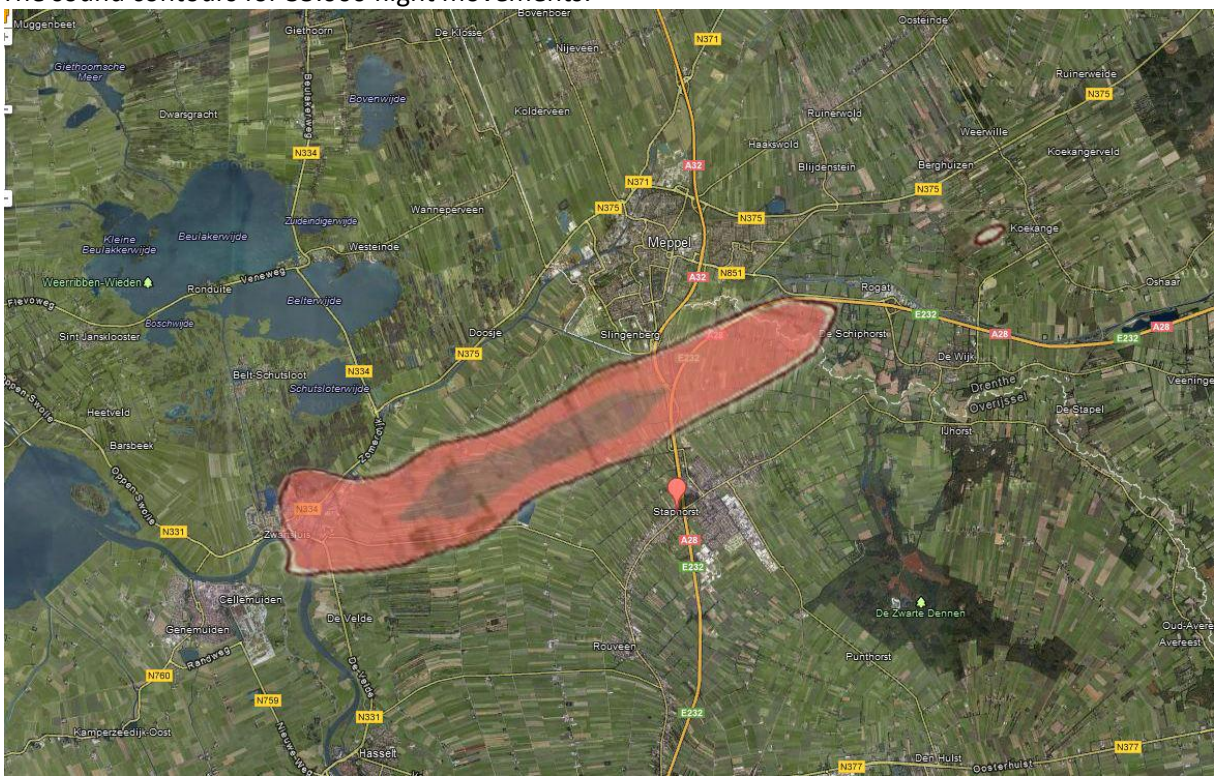
16. COLOR OF AIRCRAFT	CIVIL AIRCRAFT PILOTS, 14 CFR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.
Red/White	

FAA Form 7233-1 (8-82) CLOSE VFR FLIGHT PLAN WITH McAlester FSS ON ARRIVAL

VIII Sound contours Staphorst Airport

The sound contours for 20.000 flight movements:

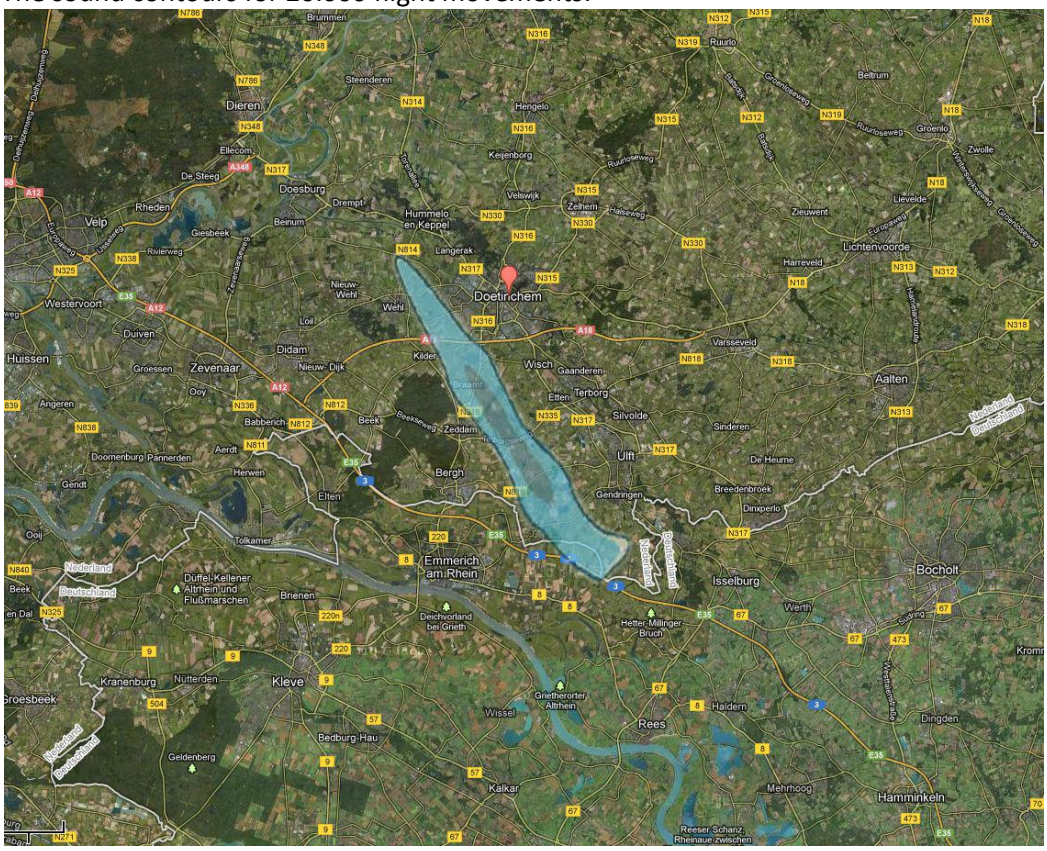
The sound contours for 35.000 flight movements:



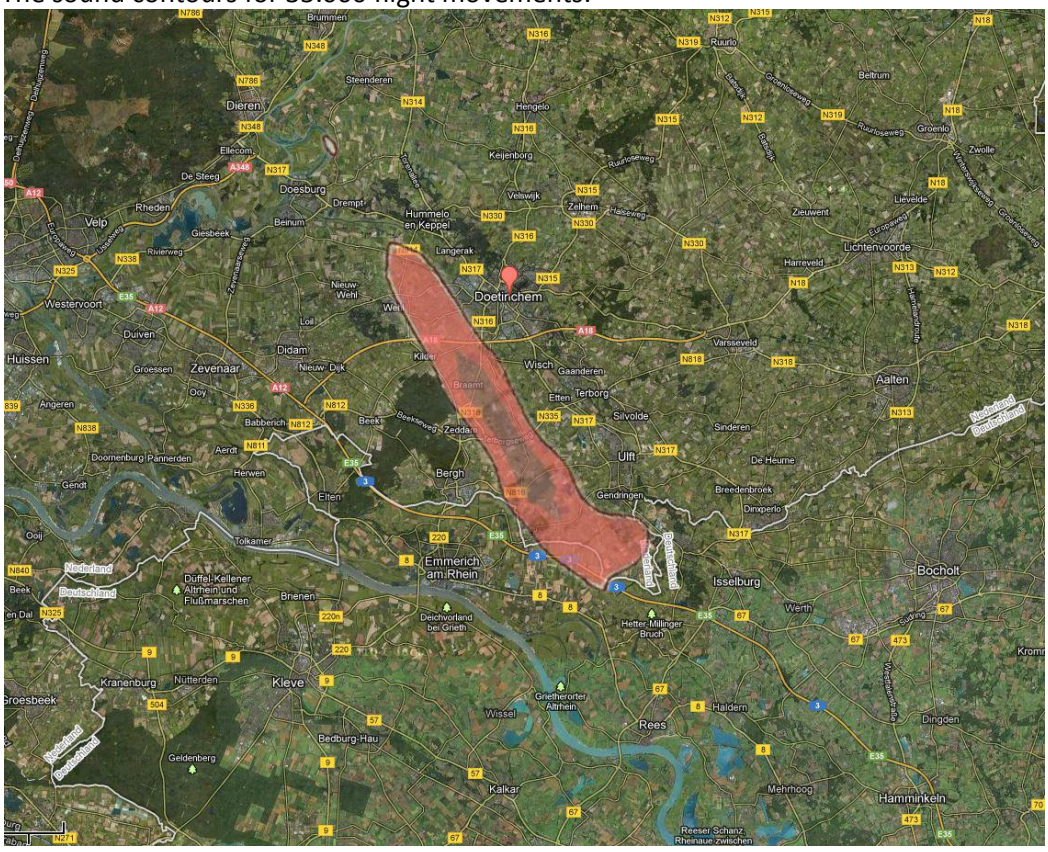
The sound contours for 45.000 flight movements:

IX Sound contours Doetinchem Airport

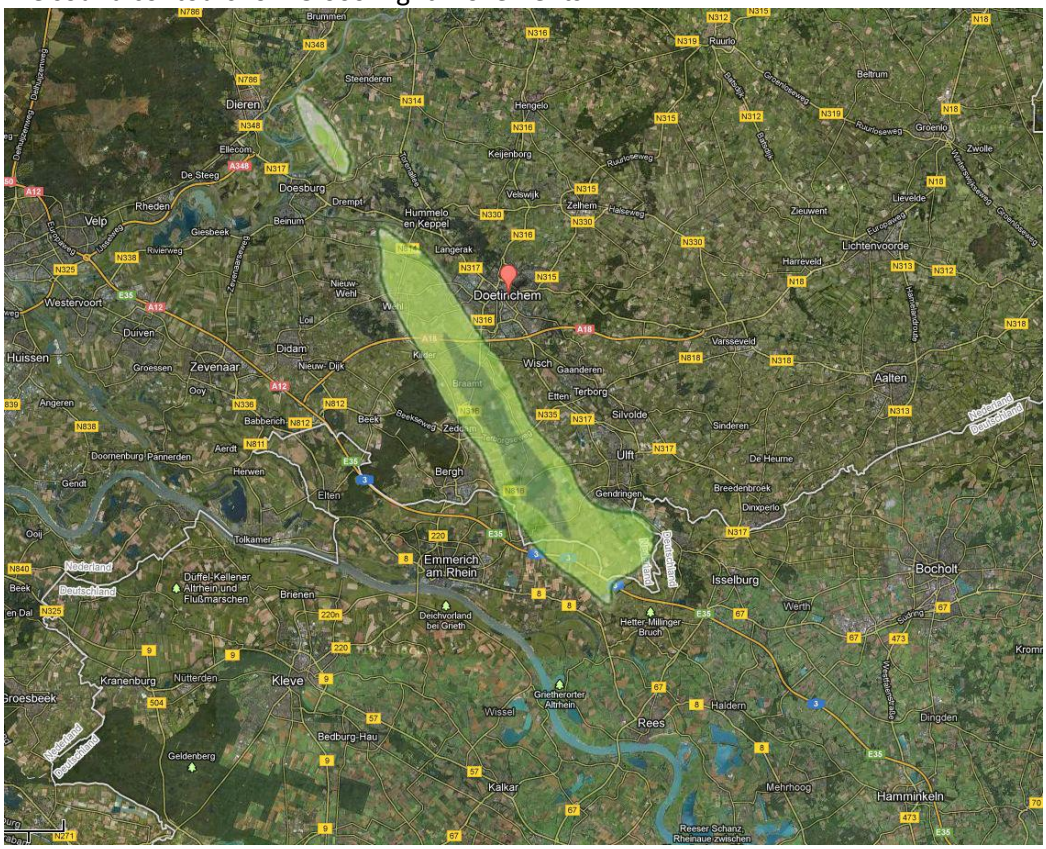
The sound contours for 20.000 flight movements:



The sound contours for 35.000 flight movements:

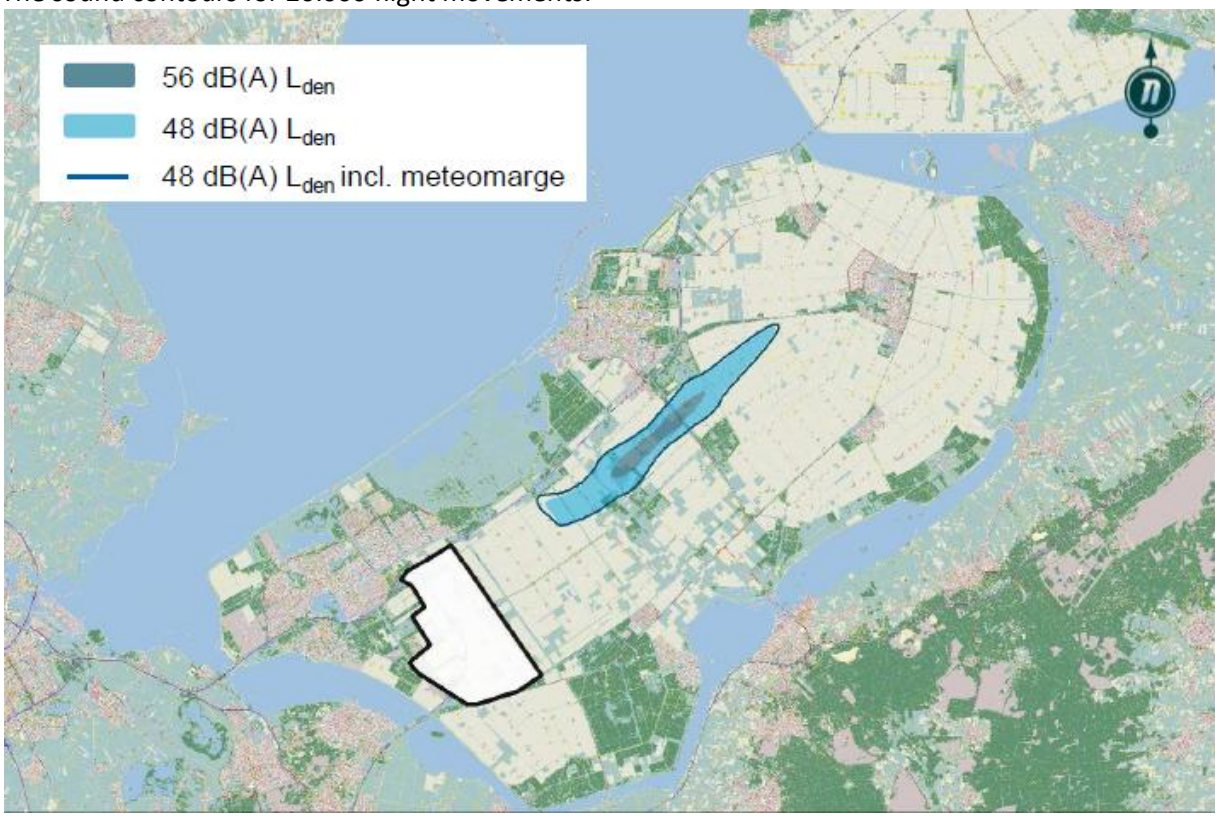


The sound contours for 45.000 flight movements:

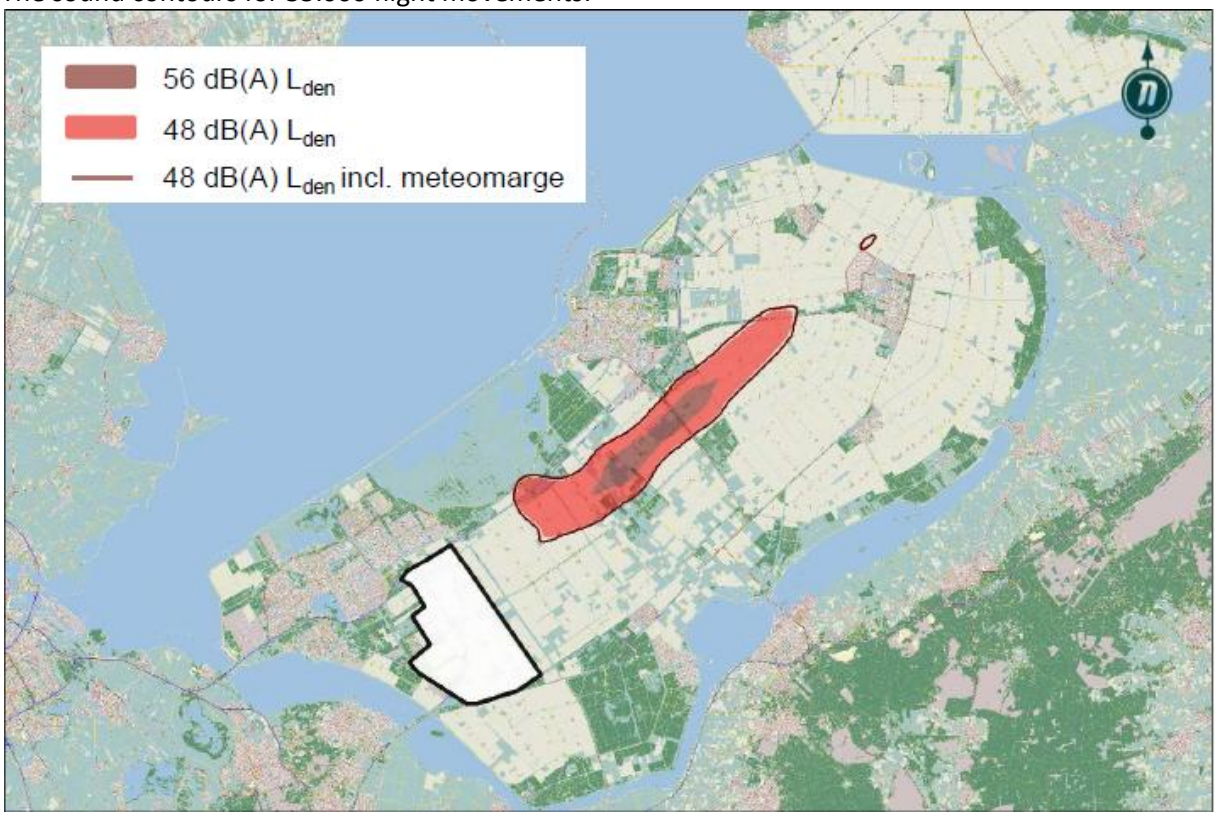


X Sound contours Lelystad Airport

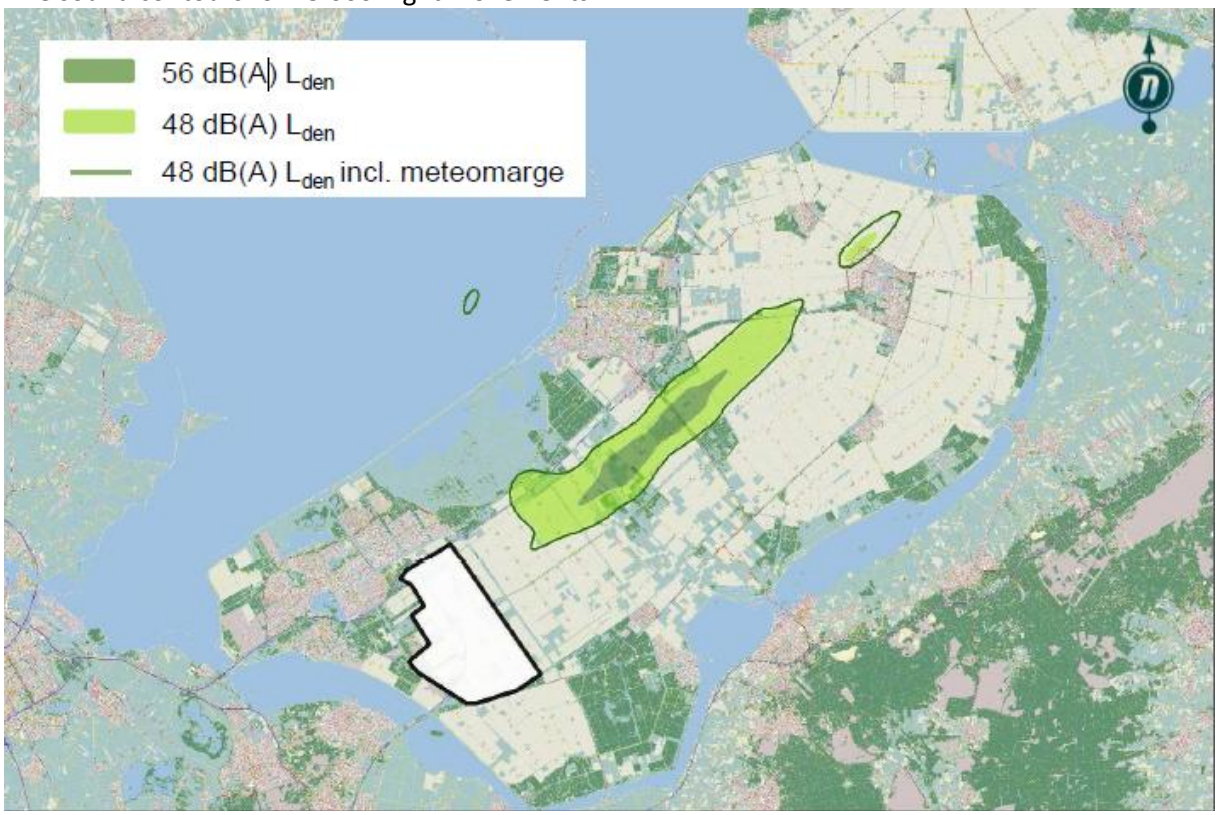
The sound contours for 20.000 flight movements:



The sound contours for 35.000 flight movements:



The sound contours for 45.000 flight movements:

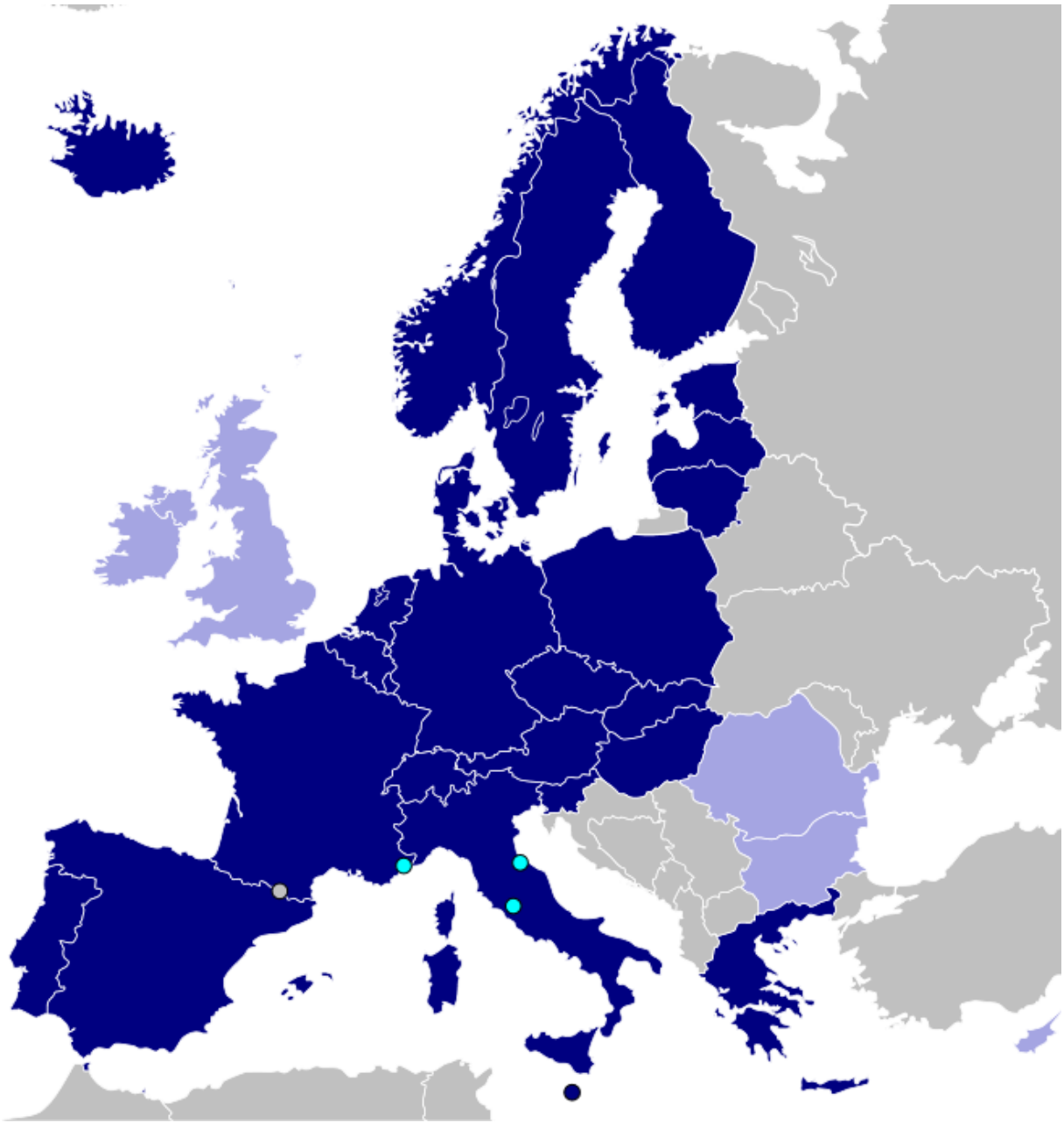


XI Countries Schengen Agreement

The following table shows the countries which are a member of the Schengen Agreement

Country	Membership date	Taking effect date
Belgium	14 June 1985	26 March 1995
Germany	14 June 1985	26 March 1995
France	14 June 1985	26 March 1995
Luxembourg	14 June 1985	26 March 1995
Netherlands	14 June 1985	26 March 1995
Italy	27 November 1990	26 October 1997
Portugal	25 June 1992	26 March 1995
Spain	25 June 1992	26 March 1995
Greece	6 November 1992	26 March 2000
Austria	28 April 1995	1 December 1997
Denmark	19 December 1996	25 March 2001
Finland	19 December 1996	25 March 2001
Iceland	19 December 1996	25 March 2001
Norway	19 December 1996	25 March 2001
Sweden	19 December 1996	25 March 2001
Estonia	1 May 2004	21 December 2007
Hungary	1 May 2004	21 December 2007
Latvia	1 May 2004	21 December 2007
Lithuania	1 May 2004	21 December 2007
Malta	1 May 2004	21 December 2007
Poland	1 May 2004	21 December 2007
Slovenia	1 May 2004	21 December 2007
Slovakia	1 May 2004	21 December 2007
Czech	1 May 2004	21 December 2007
Cyprus	1 May 2004	-
Switzerland	16 October 2004	12 December 2008, for the airports on 29 March 2009
Romania	1 January 2007	Beginning of 2013?
Bulgaria	1 January 2007	Beginning of 2013?
Liechtenstein	14 February 2009	19 December 2011

The map which is sketched below shows the countries of Europe. The schengen countries are indicated with a dark blue marking. The non-schengen countries can be considered by means of the light blue color.



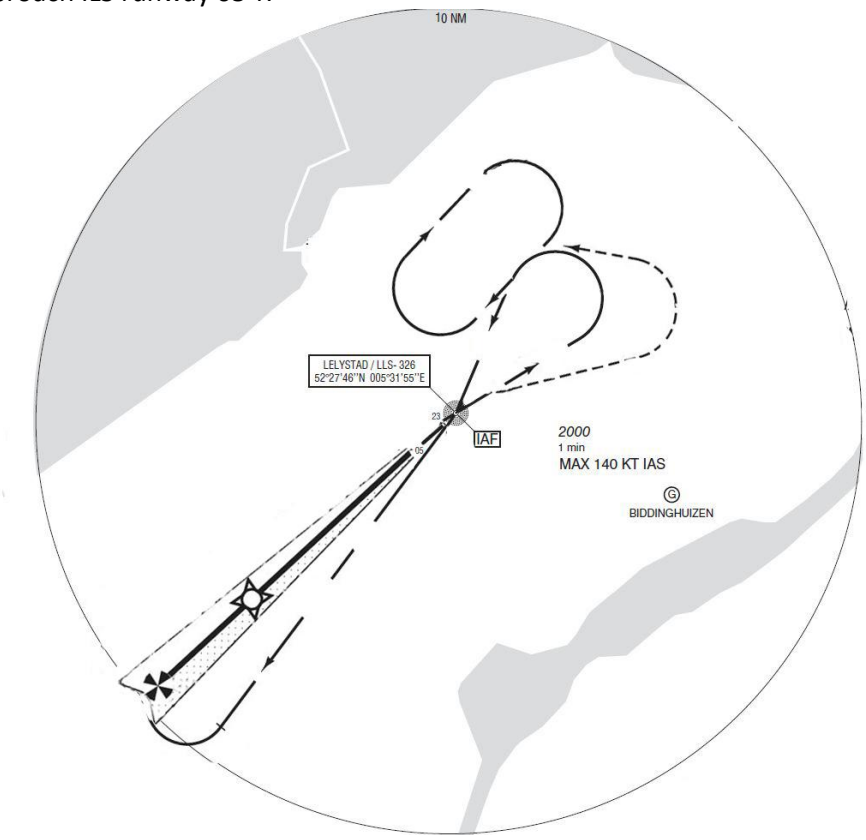
XII Runway strength

Aircraft	Weight Max/Min [kN]	Load on one main gear [%]	Tire Pressure [MPa]	Flexibile Pavement Subgrades CBR [%]				Rigid Pavement Subgrades k [MPa/m]				$\frac{S_T}{S_B}$ [cm]
				High	Medium	Low	V.Low	High	Medium	Low	V.Low	
				A	B	C	D	A	B	C	D	
				15	10	6	3	150	80	40	20	
A320-200	759 441		1.44	41 22	42 22	47 24	53 28	46 24	49 26	51 27	53 29	
B737-800	777 406		1.47	44 21	46 21	51 23	56 26	51 24	53 25	56 26	57 27	

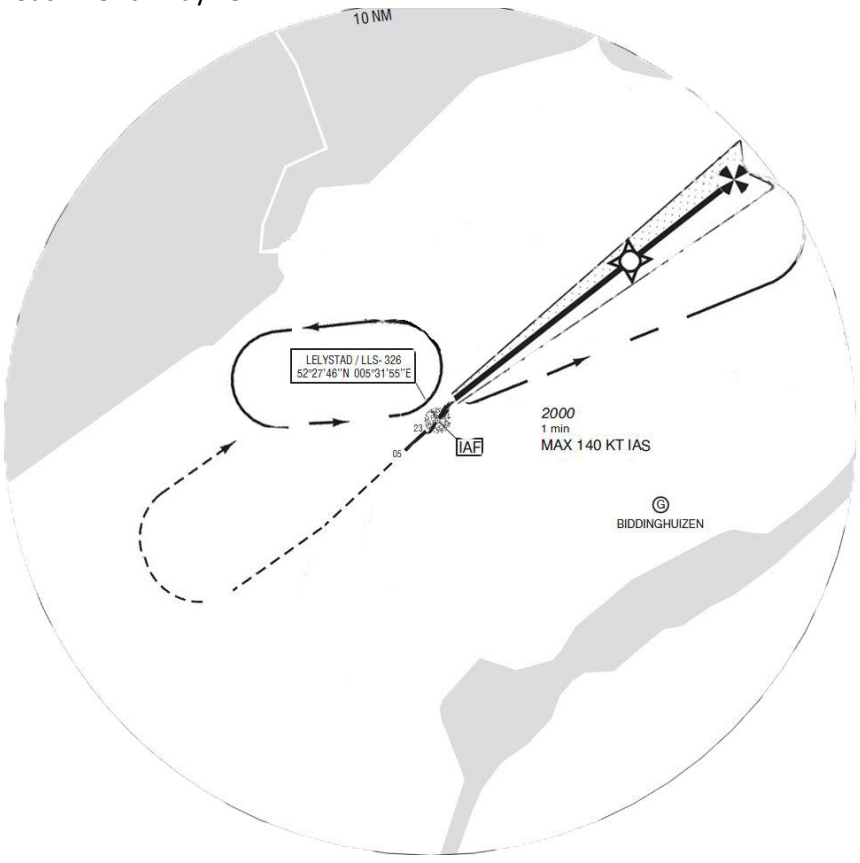
Aircraft	Weight Max/Min [kN]	Load on one main gear [%]	Tire Pressure [MPa]	Flexibile Pavement Subgrades CBR [%]				Rigid Pavement Subgrades k [MPa/m]				$\frac{S_T}{S_B}$ [cm]
				High	Medium	Low	V.Low	High	Medium	Low	V.Low	
				A	B	C	D	A	B	C	D	
				15	10	6	3	150	80	40	20	
A320-200	759 441		1.44	41 22	42 22	47 24	53 28	46 24	49 26	51 27	53 29	
B737-800	777 406		1.47	44 21	46 21	51 23	56 26	51 24	53 25	56 26	57 27	

XIII Flight routes ILS approach charts

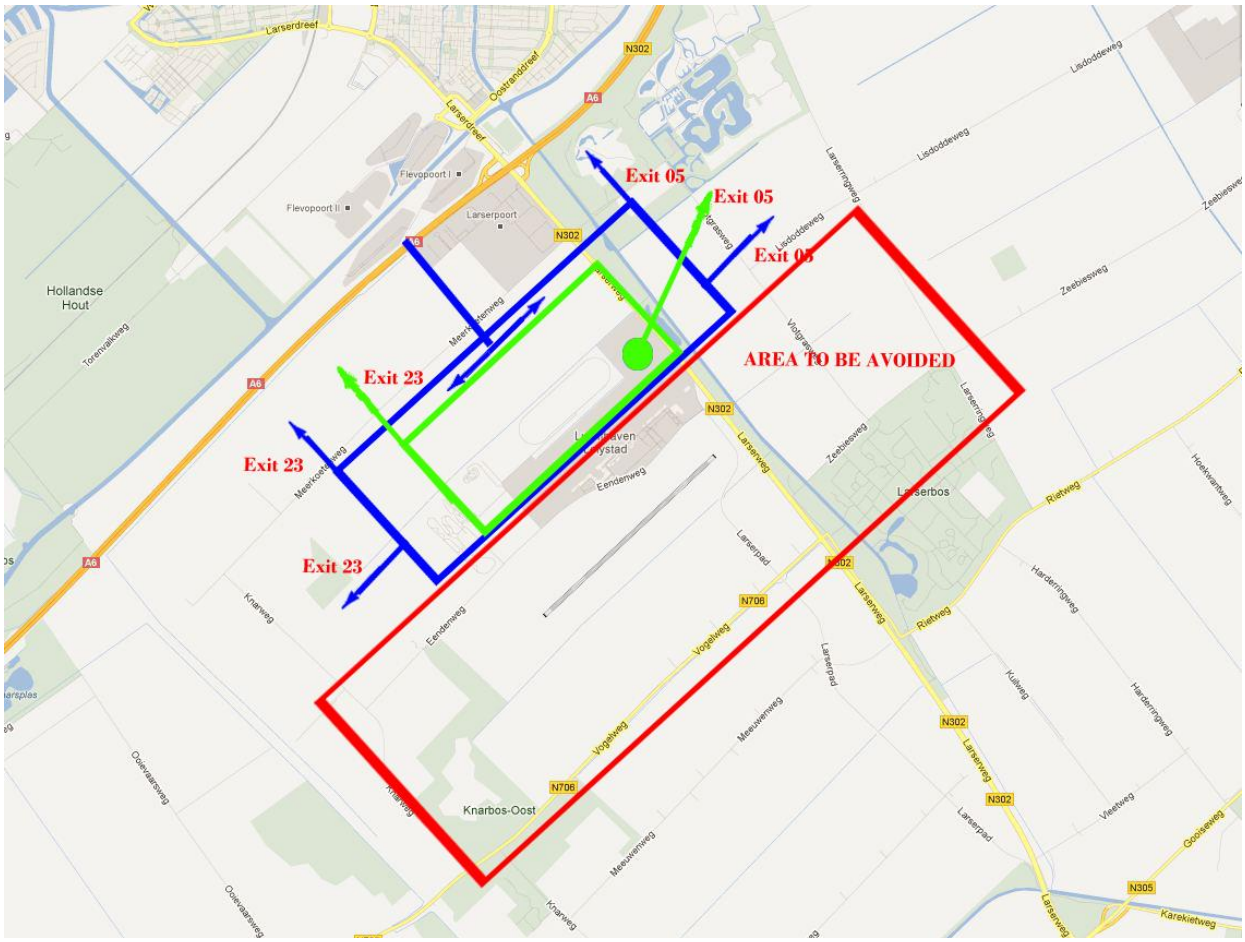
Approach ILS runway 05-R



Approach ILS runway 23-L



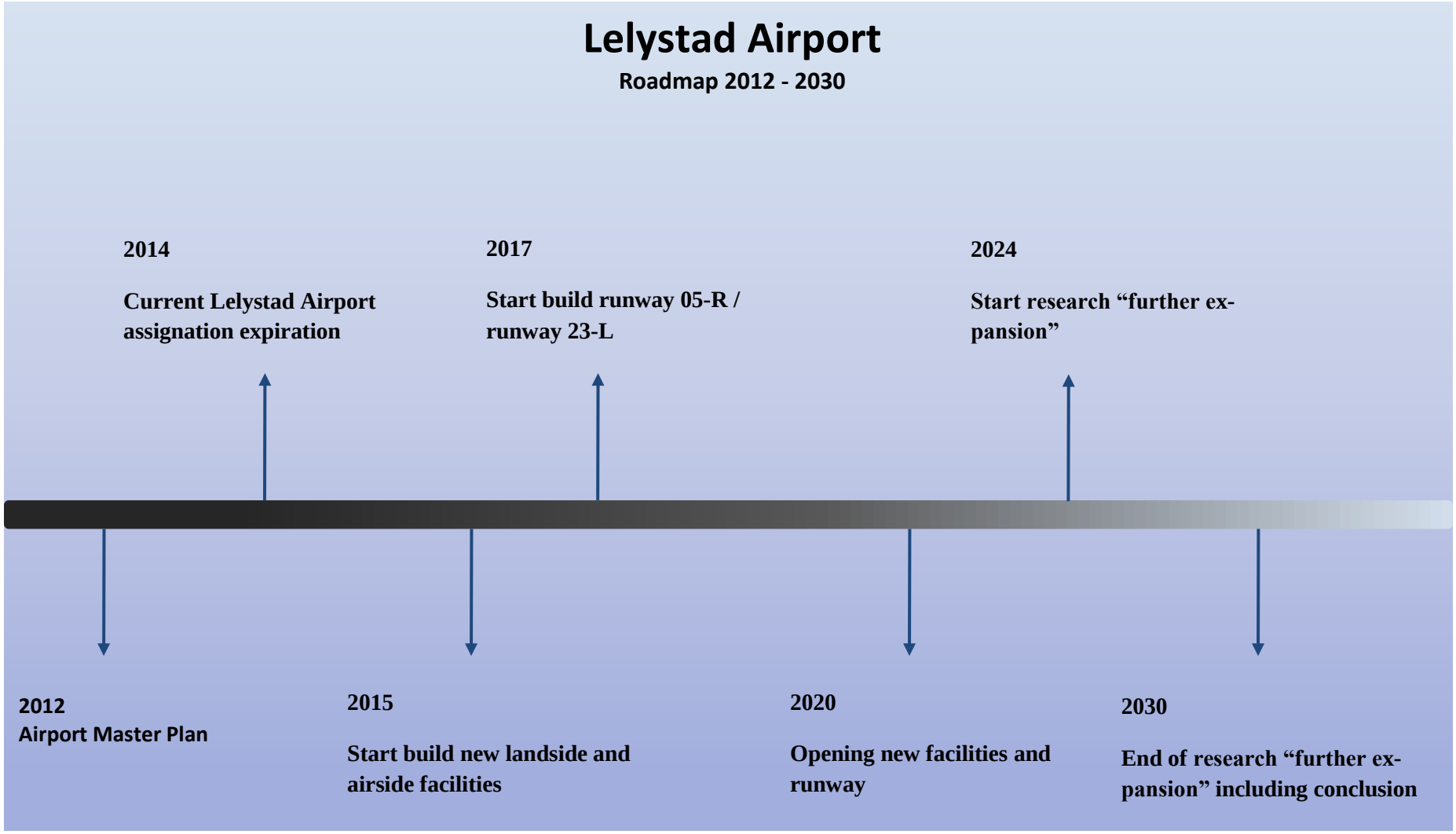
XIV VFR approach chart Lelystad Airport



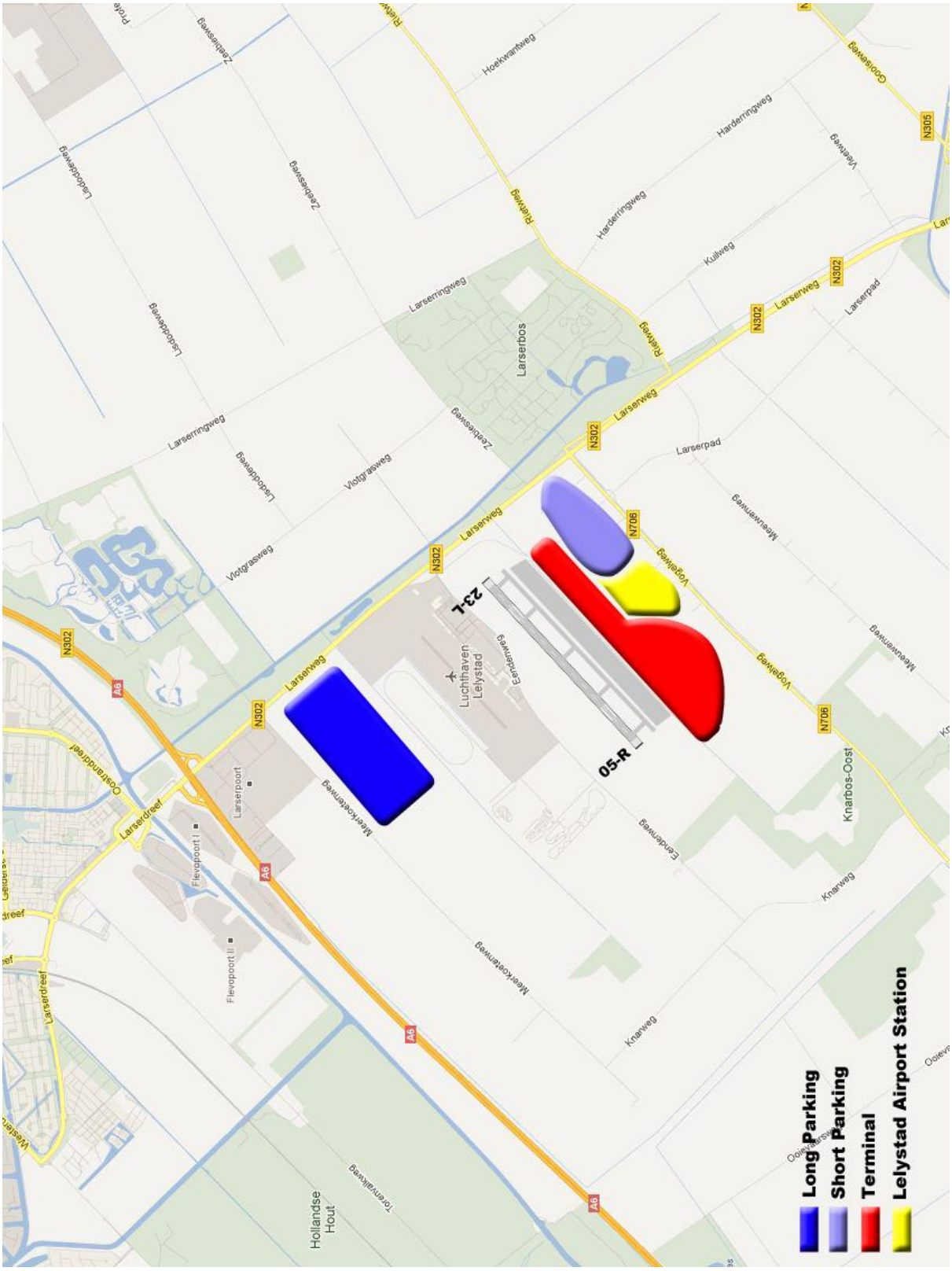
XV Sound contours 75.000 flight movements

In this chart are the sound contours for the 75.000 flight movements from Lelystad Airport sketched.

XVI Roadmap Lelystad Airport



XVII Plan Lelystad Airport



XVIII Process report

In the first week of the 4th period Jelle Bakker told us that he was not able to finish the project. He quit in the second week and we had to go on without him. The first week we divided the tasks for the project plan this went perfectly, everybody agreed on the task. We gathered the information for the project plan and we started making the work. A week later we heard from P.J van Langen that we were on the right track. We finished the project plan and started gathering information for chapter one. We had a rough start and this resulted in a loss of time. We noticed that we needed to change some things for chapter one and gave Michael Mom some extra time to finish his assignment of chapter one. The rest of the group started on chapter two, this was in the same week of the holiday. We had plans to work hard in the holiday but eventually this was not the case. This also resulted in loss of time. Eventually we divided chapter two in couples of two, only Michael would make the requirements and the advantages and disadvantages. Every couple finished their task, except for Michael. By this time he did not complete any of his tasks. This was kind of frustrating for the group. By now the group started on chapter three. There was only one week left for chapter three, so there was a big pressure. Halfway through the week we decided to take over all the tasks of Michael. This is because he did not reply to any of the group's questions. The last week Michael showed up and handed in the poster. This was a total surprise for the group, because he did not responded to anybody. Michael did not do enough for the project to make him part of it, so the group decided to dismiss him. The last weekend everybody finished their tasks. Tuesday the report was finish, printed and eventually handed in on Wednesday.