



**New Landspítali University Hospital Project (NUH)
Review of planned development**

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2 Project background and summary

Landspítali has commissioned a report on the possibilities for progressing the hospital's development proposals. The report presents alternative strategies for resolving the hospital's development requirements. The background for the report is the current economic climate and serious doubts regarding the possibilities of carrying out the hospital's plans.

The hospital's activities are today located on several sites, for example at Fossvogur and Hringbraut, which gives inefficient and difficult operations, such as doubled up emergency functions. The hospital buildings are of an age which no longer satisfies modern requirements, and future demands on the hospital's services will therefore be difficult to meet in existing premises.

The possibilities for introducing new working methods are limited. Patients, who would otherwise be treated in polyclinics or day surgeries, must be admitted as in-patients due to a lack of satisfactory premises and technical infrastructure. For many, a patient hotel would be a much better alternative than admission, and at a far lower cost to the hospital. Possibilities for improved cooperation with the university in terms of education, research and development is limited due to a lack of facilities.

The current development project resolves these issues by proposing a new development of 135,000m², and refurbishment and upgrading of some of the existing buildings, all located at Hringbraut.

This review of the development project presented in this report shows possibilities for reduction in planned total area. A critical review is recommended of levels of utilization, capacity requirements and area standards, as a step in the process of reworking and adjusting the project to suit the current economy.

The current Sketch Project has been reviewed in terms of planning, functionality, and overall logistics. The report identifies a particular need for flexibility and generality in the building proposals, so that the buildings can more easily be adapted in accordance with changing demands in the future. A demand has also been identified for alterations to be made to the Sketch Project to allow the development to be carried out in phases.

Alterations and adjustments are suggested to the Sketch Project in order to achieve this and other improvements in the ongoing planning process.

As part of the commission, an alternative concept has been developed for the project. This principal alternative shows a more general building type with a higher grade of generality and flexibility. It is also a good starting point for creating a compact and appropriate first phase, with sufficient elasticity to cater for the different needs of the future phases.

Alternative strategies for development are considered, and these are compared to the 0-Alternative which consists of doing as little as possible to the existing buildings, and continued operations on several sites. However, such a strategy also requires investment, for maintenance and refurbishment, and is estimated at 30 billion ISK over the next 40 years.

Alternative 1 consists of the current development proposals plus a patient hotel. 135,000m² of new build is proposed along with refurbishment of some of the existing buildings, with all activity located at Hringbraut. Alternative 1 is estimated at 90 billion ISK.

Alternative 2 consists of a first development phase which gives priority to the development of functions which give the greatest operational economic advantage, particularly by gathering all clinical functions at Hringbraut plus a patient hotel. This can be based on the Sketch Project, however this report shows an alternative development which establishes a better base for efficient operational economy and for future development and phased extension. Alternative 2 includes 66,000m² of new build, plus refurbishment and upgrading of some of the existing buildings, and is estimated at 51 billion ISK.

Alternative 1 is estimated to give a reduction of 7.2% in annual running costs. A series of qualitative improvements are also achieved, such as single bed patient rooms. However, due to the huge investment requirement, this alternative still results in a negative economic current value. The investment is therefore not "profitable" in economic terms.

Alternative 2 has a significantly lower investment requirement, while the reduction of annual running costs is estimated at 6%. This gives a positive current value, and as such this alternative is "profitable" in economic

terms. In addition, a series of qualitative improvements are also achieved, such as single bed in one third of all patient rooms.

It is stressed in the report that the estimated operational economic advantages apply to conditions arising as a direct consequence of new build in Alternatives 1 and 2. Furthermore, the report identifies additional operational economic savings of the same order which can be achieved through an organizational development, and that extensive new build development will be an important incentive and driving force in developing the hospital organization. The strategy should therefore be *a new building for a new organization!*

3 Introduction

3.1 Background for this report

Landspítali in Iceland has for some years been planning a new hospital in Reykjavík. An architectural competition has been held, and a winner selected. The competition project has since been developed further into a Sketch Project, which was completed early in 2008.

The Sketch Project includes a development which, when completed, will accommodate a large part of the hospital's area requirement, also into the future, together with re-use of some of the hospital's existing facilities. With current price indexes, it is estimated that the project will cost approximately 90 billion ISK. The hospital caters for a significant proportion of the nation's health care requirements, including highly specialized national functions, and also local hospital functions.

The Sketch Project also illustrates how the university's area requirements can be provided in close proximity to the hospital, in particular regarding the university functions. The concept for this is to facilitate the further development of research and education in cooperation between the hospital and the university. The actual university development is not at present included in the project, apart from those functions which are integrated with the clinical areas (approximately 6,000m²).

Developments in the world economy over the last year, and the special conditions which now exist in Iceland, have made the possibilities very uncertain for the Icelandic state to invest in extensive hospital development. The hospital has therefore itself initiated a review of the existing proposals. The aim is to find alternative solutions and strategies which will allow the planning and implementation to proceed.

This report is a contribution to such a review and alternative proposals.

The Sketch Project is carried out by Arkitektfirmaet C.F.Møller, arkitektur.is and SwecoGrøner for the engineering.

3.2 Background and goals for new hospital facilities

The situation today for the Landspítali hospital can be summarized as follows:

- Operations in several locations and facilities:
 - causes great excess in operational cost,
 - causes a lot of inconvenience for patients and their relatives,
 - is a hindrance to better professional cooperation and development;
- Operations in a lot of older buildings:
 - requires a lot of rebuilding and reinvestment in technical infrastructure to keep up with today's facility requirements (patient and working environments, ICT, medical technology),
 - is a hindrance to changing from multi to single bed patient rooms,
 - is a hindrance to changes in functions and operational procedures;
- Increasing needs of hospital services cannot be accommodated in existing facilities.

Goals for new hospital facilities may, with this background, be as follows:

- Gather several operational facilities into one, to create:
 - improved operational cost effectiveness,
 - improved patient and working environments,
 - better possibilities for professional cooperation and development, the university included;
- New facilities, to make possible:
 - single bed patient rooms,
 - new medical procedures and technological development,
 - flexibility for future medical and technological development.

3.3 Scope of work for our commission

The commission was confirmed by Landspítali, letter dated 25.02.09, in accordance with the scope of work as proposed by Momentum Arkitekter AS and Hospitalitet AS, letter dated 11.02.2009.

In the letter of 11.02.2009 the following was defined:

Task

The project has reached the stage of completed sketch design, with a concept study and preliminary cost estimate. In addition to evaluating the work carried out to date, we consider the task ahead to consist of identifying the development alternatives which should now be investigated, and alternative strategies which may be appropriate and possible for the project.

Initially, we consider the following should be investigated:

- *Review of overall capacity requirement calculations in relation to the general population, and the requirement for hospital functions both in relation to population size and demographic build-up.*
- *Review of the calculation of capacity due to the population and health panorama*
- *Review of the brief, in particular the schedule of areas and organisational requirements, as the basis on which the proposals are formed (Norwegian: program).*
- *Principles for the overall development plan and for the individual buildings, possibly also including area and cost generating factors;*
- *Review of preliminary cost estimate;*

Regarding the strategy and concept phase:

- *Alternative development patterns;*
- *Analysis of phased development, use of both existing and new hospital buildings over a period of time;*
- *Postponement of university or other functions, review of extent of integration in the project;*
- *Relationship to possible research functions;*

- *Alternatives for the non medical ancillary and administrative functions;*
- *Consequences of the 0 alternative, identification of necessary initial investment, and expenditure over time.*

In the course of the work it may be useful to include specialist consultants to assist in the evaluation of alternative development proposals or structures which form the basis of the project. This may include consultants in building economics (cost estimates) and some of the technical disciplines such as mechanical (HVAC) and structural engineering.

The commission was later summarized in the following main tasks:

- Review of the Sketch Project, with proposals for adjustments;
- Alternative development concepts, emphasizing implementation in stages;
- Comparison between 0-Alternative and Sketch Project.

3.4 Working process

There have been two meetings with the consultants and the representatives for Landspítali. The first meeting, held over two days, was an introduction to the Sketch Project and the situation at the hospital. The consultants presented their working method. At the second meeting the consultants presented their work completed thus far, including analysis, questions and preliminary conclusions. As set out in the Scope, this also included presentation of an alternative development concept.

A preliminary PowerPoint presentation was sent to Landspítali on 25.03.2009.

The report was delivered on 03.04.2009.

3.5 Governing documents

The following documents form the background for the project and basis for the commission:

No	Topic	Governing document
1	Overall capacity requirements	User work for organisation of new hospital, Steering Committee Report Part I Dec. 2004 Landspítali
2	Calculation of capacity Main brief (HFP), schedule of areas	Function programme Landspítali-University Hospital General part Final edition, January 2007 CFM
3	Programme	Export from dRoFUs after updates 12.11.2008
4	Sketch Project	Sketch Project Report 28.02.08 CFM
5	Cost estimate	NUH-H001_P_00_99_DSD-001 All Buildings areas and cost estimate excel
6	0-Analysis	Excess operational cost of somatic units at Hringbraut and Fossvogur, Landspítali 28.11.08

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4 Review of the Sketch Project

4.1 Background and Scope of Work

An important part of the commission includes a review of the current sketch project. The initial task was defined as:

Review the principles for the overall development plan and for the individual buildings, possibly also including area and cost generating factors.

The background for this review is a requirement to consider whether the large development planned in the sketch project can be reworked to be more feasible in the current economic climate. It is not deficiencies in the sketch project which necessitate this review, but rather a question of the project's economic sustainability. The Sketch Project seems to be well planned and balanced in its solutions. New requirements, however, such as building in stages and longer periods between the building phases, might lead to a conclusion that major changes are necessary.

Both the health planning consultants and the hospital itself have invested a great deal of valuable work in the Sketch Project. In the short period allocated for this review it has not been possible to consider all the issues to the same level of detail as in the Sketch Project. It has therefore only been possible to carry out a relatively brief review, where the main goal has been to identify adjustments which could make the project more realistic and feasible. This also includes a study of how to divide the project into stages which can function well during the development period, until a whole new build hospital is completed.

The following has been reviewed, based on the available documents and information:

- Business plan, capacities, design brief;
- The Sketch Project's physical proposals, with focus on functionality.

4.2 The Design Brief

The basis for the Sketch Project's sizing and physical proposals, in particular the overall governing logistics, shall be:

- The organization's contents – business plan, limitations and relations to other hospitals and private operators;
- The population base, with prognoses and demographic projections up to a defined planning horizon;
- Disease development, and development of treatment methods;
- Volumes of production, levels of utilization and capacity requirements
- Area standards and net/gross factors
- And as a product of all the above – room and area requirements.

One factor has made it quite difficult to get to grips with some of the issues in the Sketch Project identified for special consideration, and that is that the brief and the proposals are combined in the same document, where both have been prepared by the same consultant. Normally, the brief would be developed and ratified as a separate process, so that all requirements are clearly and unambiguously defined as a basis for the design.

These issues are therefore not all examined in depth in this report, however the following should be developed further in the next stage of the project.

The organization's contents – business plan

A critical question is to what extent other hospitals and private operators affect the sizing of Landspítali. Furthermore, if the decision is made, for example by not making any decision, not to undertake a redevelopment of the hospital (the 0-Alternative), it may become necessary to review which of the hospital's functions and tasks can be moved to other operators.

In any comparison between Landspítali and other hospitals, it is important to take into consideration that Landspítali is a national hospital which to a large extent must cater for all the healthcare demands of a relatively small population. This leads to a requirement for some areas of relatively low grade of utilization, which again leads to a larger area requirement

than other similar hospitals. The extent of this should be critically reviewed in the ongoing process to prevent the generation of unnecessary area requirements.

Such requirements underline the importance of generality in the chosen proposals, so that the rooms which are planned can serve several purposes and thereby achieve a high grade of utilization.

The population base

The timescale for sizing and the expected population development have not been considered in terms of the available documentation. It has been registered, however, that the hospital itself has gathered data showing significant divergence from expected population growth, which is growing faster than anticipated. It is also currently being considered what effect the current economic climate may have on demographic development.

These are issues which must be considered more closely, and which can have consequences for both sizing in the long term and which development strategies are chosen.

Disease development, and development of treatment methods

An important question in this context is the development of treatment methods, in particular increasing day surgery and out-patient treatment, use of patient hotel, etc. During the Sketch Project, new reviews have been carried out, for example of bed capacity, however they are poorly documented and should be reviewed again in the ongoing planning.

Volumes of production, levels of utilization and capacity requirements

Documentation is lacking for the calculation of capacity requirements, particularly regarding sizing of polyclinics and emergency arrivals. The issue of opening hours is an important factor in calculating capacity requirements, and in several Norwegian hospital projects in recent years has been important in relation to necessary area reduction.

Area standards and net/gross factors

Significant divergence from accepted area standards have not been identified, compared to Norwegian and Danish hospital projects, apart from area standards for wards. On this point the documents are somewhat unclear, and the areas seem to be higher than in comparable projects, in

fact as much as 60% higher than would be expected. This must be considered more closely in the ongoing planning.

The gross area for the new build part is approximately 135,000m², and net area is stated as approximately 67,000m². This gives a gross/net factor of approximately 2.0, which is an accepted level of area utilization in hospital planning. Experience suggests, however, that the definition of gross/net factors can vary greatly and give very different gross/net factors for the same project. The necessary information has not been available to take this study further.

In the review of the proposals contained in the Sketch Project, issues and conditions are identified which can improve even more the level of area utilization by employing more compact solutions.

Room and area requirements

The Sketch Project is very detailed in terms of showing all the individual rooms. This form of detailing would normally be undertaken in the following Outline Design stage (*Norwegian: Forprosjekt*). The resulting Schedule of Areas for rooms has therefore not been considered at this stage of the planning process.

4.3 Summary of area requirements

After a review of the Sketch Project and the brief on which it is based, the following conclusions can be drawn:

- Area requirements must be reviewed, particularly if the project is to be carried out in phases. It will then be important to size the first phase as correctly and appropriately as possible;
- Population base, levels of utilization and capacity requirements must be documented in more detail in relation to the current situation, and also in relation to a phased development should that become relevant;
- Area standards correspond to accepted guidelines for hospital projects generally, apart from areas for wards which should be critically reviewed;

- Area efficiency appears to be good, however potential for further improvement has been identified.

A crude estimate has been prepared for the total area requirement for the hospital, based on very modest brief requirements taken from a recent Norwegian hospital project. The estimate indicates that it may be possible to plan the new hospital with a lower total area but without any reduction in quality or capacity. The estimate must be corrected as the hospital will incorporate national functions, which give slightly higher area requirements compared to similar hospitals with regional or local functions.

For information, the table below indicated some key figures for the Sketch Project compared to two similar hospital projects in Norway.

	NUH Sketch Project	Nye Ahus	Nytt Østfoldsykehus
Population to-day	319,000	303,000	262,000
Population prognosis	2030: 330,000	2015: 340,000	300,000
Gross area new buildings	135,000	113,000	87,000 Psychiatry incl.
Gross area existing buildings used	46,000	23,000 Patient hotel incl.	25,000 Patient hotel incl.
Number of beds somatic	487	638	509
Operating theatres	22	20	19

4.4 Site plan



Site plan, Sketch Project, March 2008. Arkitektfirmaet CF Møller, arkitektur.is, Schønherr Landscape

A discussion of the location at Hringbraut is in itself not part of the commission.

However, if this was to be considered, it could be questioned whether it would be more advantageous for the new hospital to be planned and built on a new site. The impact of this would be that all hospital functions would have to be built in mostly the same period in order to give the required output for economic savings in the running cost. With such an alternative it is more difficult to build in phases, and the use of existing buildings which are of value for the future could not be used as part of the hospital.

4.4.1 Site and size

The site at the existing hospital at Hringbraut is about 76,000 acres. The site for the new buildings is about 176,000 acres. Total about 252,000 acres for the whole complex; compared to other hospital projects this seems to be a sufficient site area for a hospital at this size.

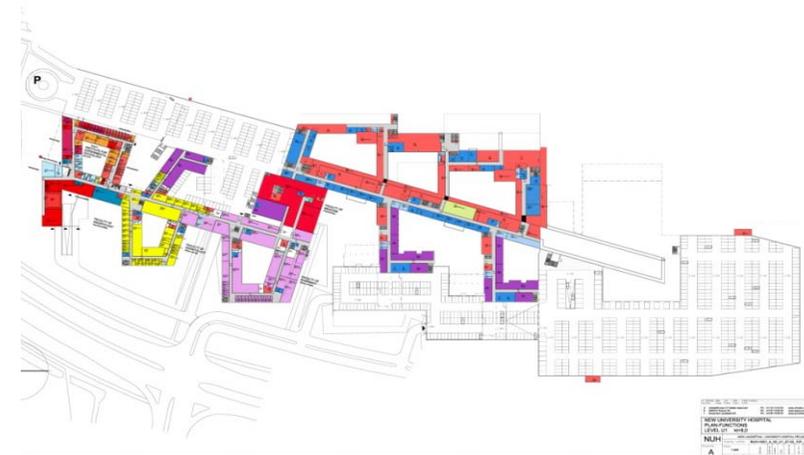
The site has an adequate area for the new project, but not much possibility for extension in the future. Current experience tells us that hospitals mostly need more space as time goes by. With this starting point it is obvious that any future renewal or extension will incorporate the site for the existing hospital.

Consider that the site on the south side of the motorway should be reserved as an area for future extension of both the hospital and university.

It is an appropriate starting point that the site allows the new complex to be established close to the existing hospital. It is also a most positive factor that the site has a long flank towards the existing hospital, which allows many access points to be established between the new and existing parts.

It seems natural that the main new axis is east-west and that the University is located to the west.

4.4.2 External traffic, parking



Parking and access roads

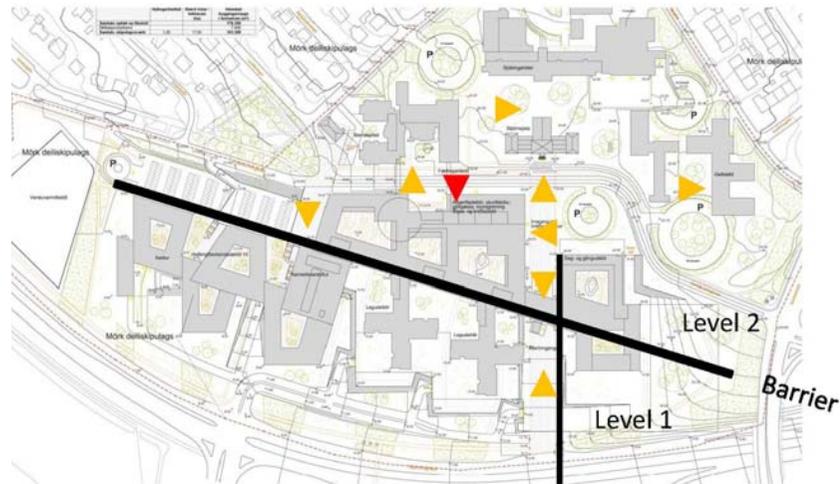
The external traffic is well planned. The main traffic is located south of the complex, and parking also located to the south along the outer border of the site. There are many approaches to the parking areas from the internal road. It can be questioned if the junction to the motorway has enough capacity for the morning and afternoon rush hours to handle about 3,000 cars.

A connection between the access road to the south and the junction to the east should be considered.

It can also be questioned if there will be a conflict between the ambulance entrance on the north side of the new complex and the main internal road. This main internal road will be an important pedestrian route and outdoor connection within the complex. The ambulance entrance is also facing the entrance to the children's department.

The location of the ambulance entrance should be considered to avoid conflict with pedestrians and the entrance to the children's department.

4.4.3 Connection to the existing hospital



Barrier

Entrances in the new hospital

There are few axes or connections from the new part to the existing hospital. The only functional connection is between the operation department in the new part and the children and women's departments in the existing parts.

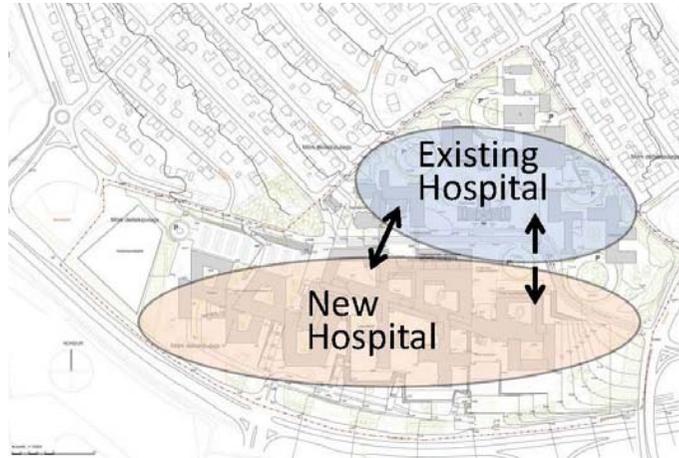
The non medical services have good connections in culvert tunnels.

The thick line in the sketch above illustrate the barrier created when the main entrance in the new part is on a lower level than the other areas. The entrance wing between the treatment and out-patient building also represents a sort of functional barrier.

Consideration should be given to locating the main entrance to the new part on level 2. The split entrances in the Sketch Project with one entrance on level 1 and one on level 2 should be avoided.

4.5 Building concept

4.5.1 Principles



Principle illustration showing the relationship between the existing and new part of the hospital

In the Sketch Project the concept for the new buildings is based on the principle that the new part is a complete hospital. The exception is the connection to the children's and woman's departments and the non medical services which remain in the existing part.

This means that the concept assumes that most of the retained existing hospital buildings will no longer accommodate medical functions. They will instead accommodate functions such as patient hotel, offices and so on. It has also been assumed that some of the buildings with low user quality should be demolished.

The result of this is that the new hospital will to a large extent be separate and "stand alone" in relation to the existing hospital.



Principle illustration showing an alternative relationship between the existing and new part of the hospital

It should be considered if the principle demands for the new part should be considered as an extension to the existing buildings rather than a new hospital adjacent to the existing.

4.5.2 Generality, flexibility and elasticity

Definition:

- *Generality* is defined as the ability for the buildings and structure of rooms to be used for different types of functions without changing or rebuilding.
- *Flexibility* is defined as the ability to change a defined area for adaptation to new functions without changing the basic installations or constructions.
- *Elasticity* is defined as the ability to extend the complex, building to new area requirements, such as expanding the building with new floors or new buildings.

The treatment building

The building is the heart in the hospital, logically located in the centre of the complex. There are connections to the children's and woman's departments in the existing buildings.

The different parts of the building are constructed with various widths suited to the various functions. The building widths are tailor-made for the functions of today, and give less generality and flexibility for change and development in the future.

Most of the wings are about 15–18m wide, which is a narrow building type for hospitals. In the Sketch Project there has been a requirement to provide good daylighting conditions to all areas. This requirement can, however, be satisfactorily achieved in a building of 23m width, which is a more appropriate width for hospitals.

In hospital projects, demand for change will be present both in the planning and construction period, and in the whole life cycle of the hospital.

It is not possible to make further extensions to the building. As such there is a lack of elasticity. Consideration should therefore be given to creating a general communication axis from south to north towards the eastern side of the complex. This will allow further development and increase the elasticity of the concept.

The out-patient building

The topics and comments noted above for the treatment building are equally relevant to the out-patient building.

Laboratory building

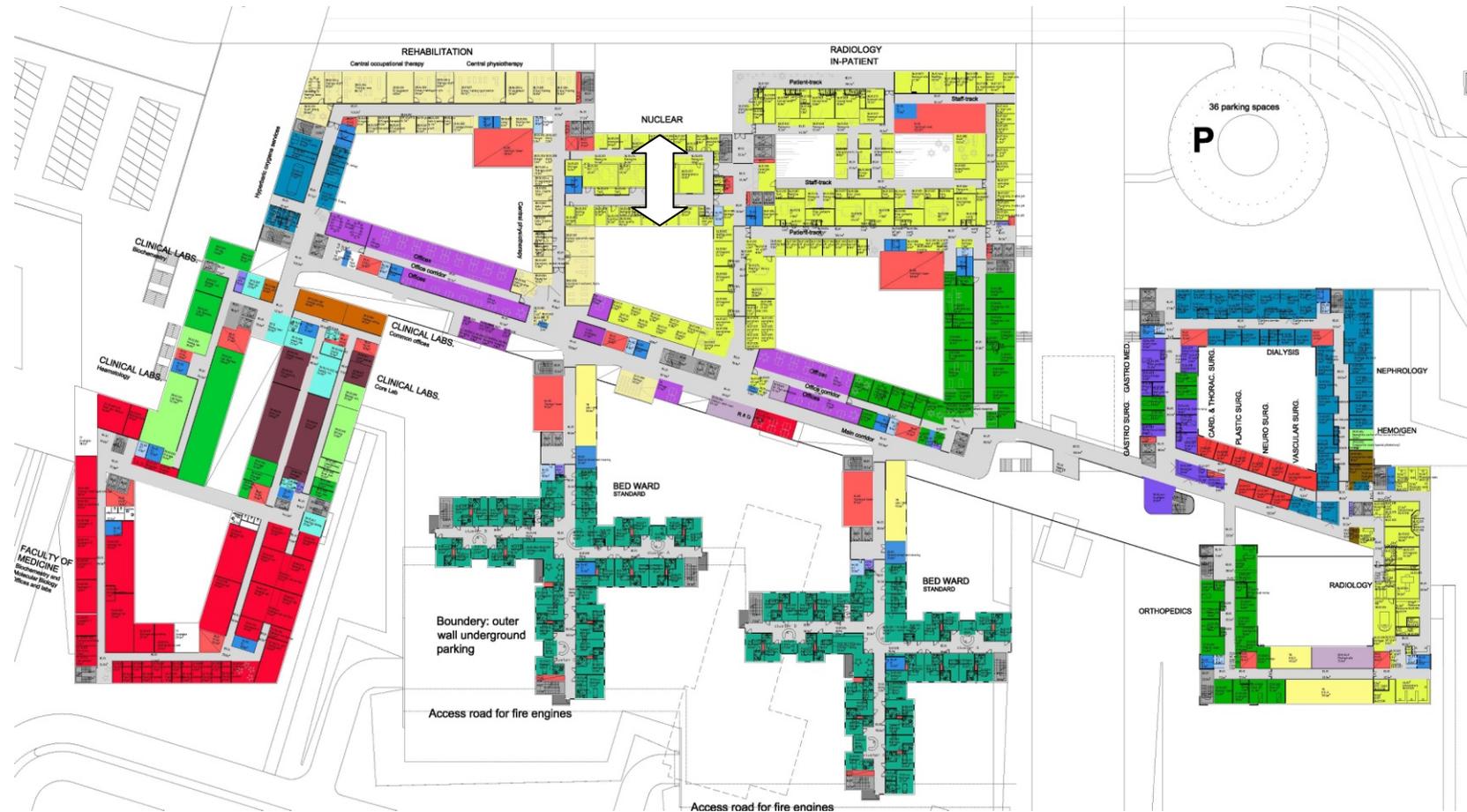
The laboratory building is planned in combination with both the university laboratories and teaching facilities. It might be difficult or expensive to provide a coordinated structure appropriate for both a laboratory building and teaching facilities with large rooms. Consideration should therefore be given to collecting all the laboratories in one wing or building and the teaching facilities in another wing or building.

In this way it would be possible to make more effective buildings, and buildings with high generality and flexibility.

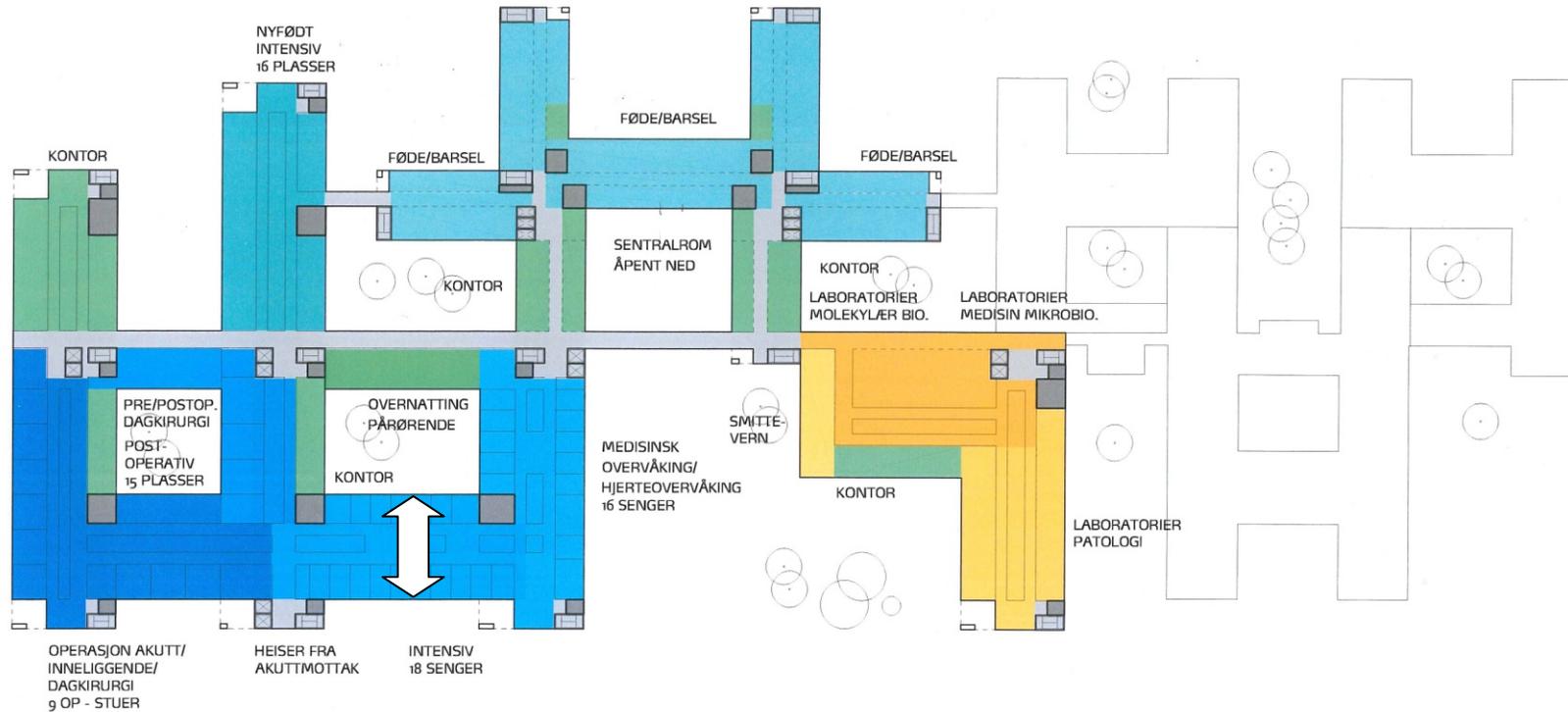
Wards

The change of concept for the wards on the south side of the main street is not reflected in the concept on the north side. The new principles for the wards reduce the connections between wards and treatment building, both in numbers and locations. The corridor from the eastern bed-wing should face the same corridor line in the treatment building to be an effective transport line.

Below is shown an example for a project with standardized building structure. The blue parts are the treatment functions with a building width of 23m. The green areas are wards and the yellow are laboratories.



Sketch Project 2008, Level 3
The arrow indicates a building width at 23m



Sketch Project Nytt Østfoldsykehus, Norway 2008
The arrow indicates a general building width of 23m for the treatment building

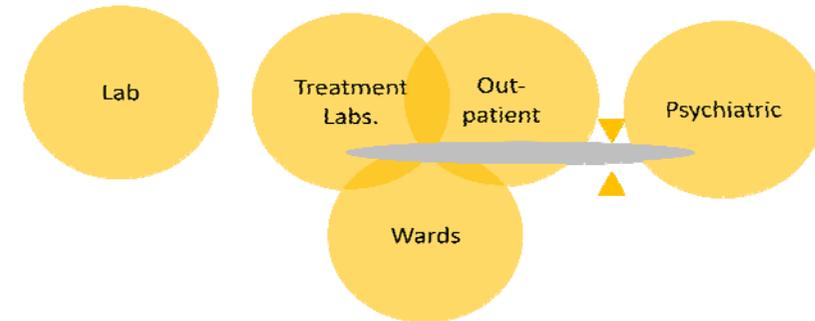
The following should be considered to increase generality and flexibility:

- Change the width of the treatment and out-patient buildings to a more general building width. Consider a general width between 22 and 24m. This will increase the generality and flexibility.
- Consider collecting the laboratories in one building, or relocate together with the treatment functions which have the same requirements for building structure.
- Continue to develop the change of concept for the wards so that they are coordinated with the concept for the treatment building.

- Consideration should be given to a general communication axis from south to north towards the eastern side of the complex. This will allow further development and increase the elasticity of the concept.

4.6 Functional layout

4.6.1 Mutual location of functions, relations between them



*General principle for location of main hospital functions
The grey line is the main street or corridor*

As an overall view, the mutual location is well planned. The main functions in the treatment building are logically located on the different levels. The wards are located in separate wings connected directly to the main street and the treatment functions.

Wards

It can be questioned whether the eastern ward should have a more rational and direct line into the adjacent corridor in the treatment building.

The buildings for the wards are, quite naturally, planned for this special function. A ward building has normally less generality and flexibility than the other hospital buildings.

Out-patients

The main issue regarding mutual location is the location of the out-patient function in an own building.

The reason for a separate building is a requirement to separate out the flow for out-patients and day treatment. These patients normally arrive by themselves and go home immediately after the examination or treatment. It is further assumed that routines for working in a separate building have been developed as an effective way of ensuring that staff are not disturbed by more complex activities and situations in the treatment building and wards for in-patients.

On the other hand, however, location of the out-patient functions in a separate building creates a static situation with less opportunity for development or changes in the out and in-patient treatment areas, or the functional combination of medical disciplines.

In other hospitals it has been a goal to be able to locate the various functions of smaller medical specialities in small centres to increase effectiveness, maximise cooperation and strengthen the skill of the personnel.

It is possible to establish combined buildings both for in-patient and out-patients. It would normally be an effective solution, also increasing generality and flexibility, to have the treatment departments for in and out-patients located “back to back” and to keep separate the flow and treatment lines.

This principle also improves effectiveness for both staff and equipment for many parts of the hospital. For instance the X-ray department can make more effective use of the expensive installations and with less staff.

Main Street

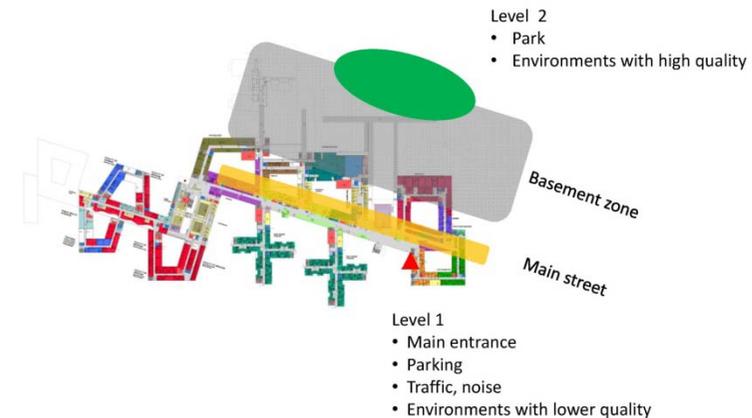


Illustration of the Main Street

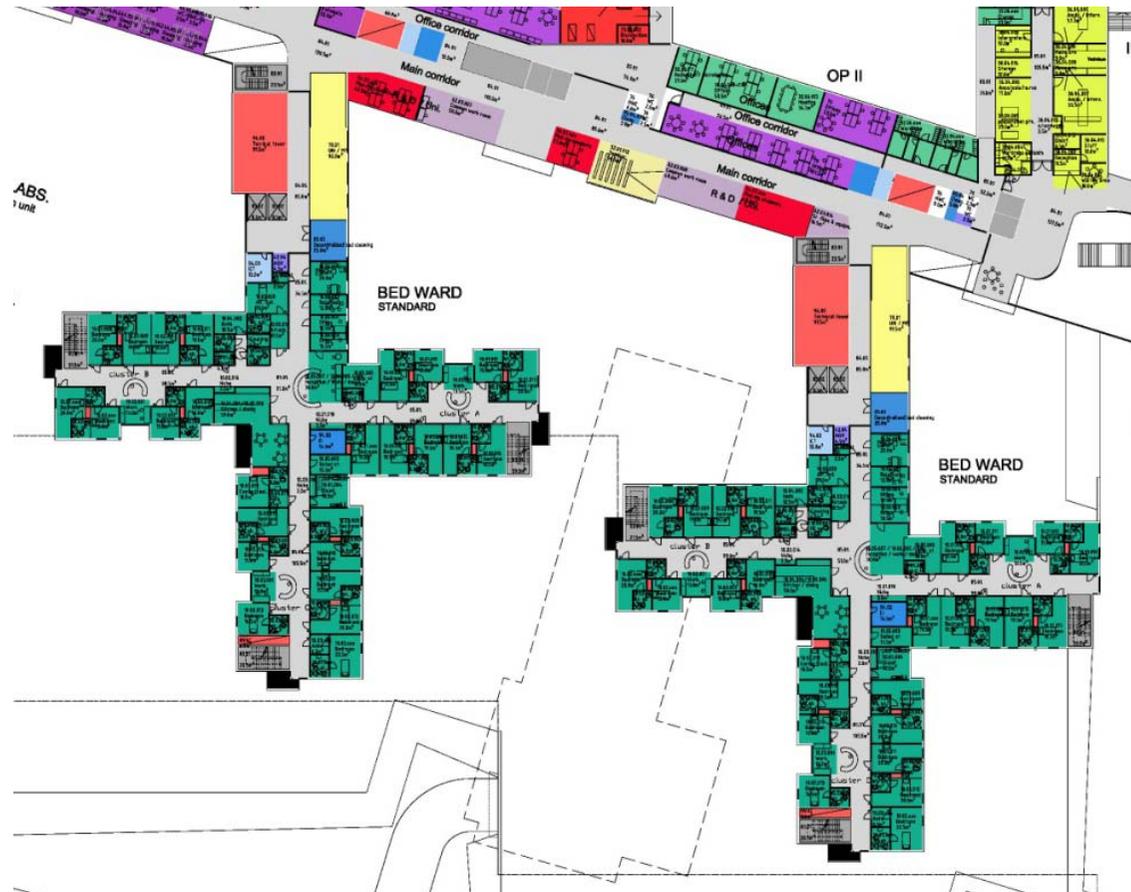
Normally it is a goal to create an attractive and living main street, giving as similar an impression as possible to that of a normal street or public place. In order to achieve this, as many common and “attractive” functions as possible are located along the main street to ensure activity and large numbers of people.

The main street in the Sketch Project is on level 1 facing the main entrance on the same level. The staff cafeteria and visitor cafe are located on this level. The reception for out-patients is also here, located close to the information desk by the main entrance.

However, a major part of the internal traffic and entrances within the hospital complex, also regarding the existing part, are on level 2. The functions on the north side of main street, which is partly underground, will also not normally be public functions.

Consideration should be given to relocating the main street to level 2 and combining the various entrances into a single entrance on level 2.

4.6.2 Wards



Sketch Project, Wards

The concept for the wards has been changed from the architectural competition in 2002 with L-shaped footprint to a cross footprint. The reason for this change has been a requirement to reduce the length of corridors and the distances the staff have to walk between the bedrooms and service facilities within the wards.

This principle is now used in several hospital projects. To increase the flexibility consideration should be given to whether the two facing wings can be connected. With this solution it would be possible to have flexible borders between the bed units and ward units. It would therefore also be possible to have a large ward, for instance with patients who need less

intensive nursing, and smaller wards for patients who need more. This flexibility might also be used in the weekends with fewer patients and less activity.

The illustration below follows this example:



*Principles for wards.
Sketch Project Nytt Østfoldsykehus, Norway 2008*

One level in the Østfold project contains:

- 72 beds,
- 2 wards per level
- 36 beds per ward
- 4 bed units per ward
- Bed unit: 5 single bed and 2 two bed rooms.

4.6.3 Flow of patients, visitors and staff

Patients

There are effective flows for patients arriving in the emergency reception area from the ambulance and ambulatory entrances, moving to the examination rooms and to the emergency treatment areas. Also moving further into the building, to the observation beds and to the operation theatres. The X-ray department also has a logical location in relation to this flow.

It is assumed that the elective patients will arrive at the main entrance on level 1 and then walk by themselves directly to the out-patient wing or to the wards. This is a logical flow and principle.

Visitors

Visitors are assumed will arrive by car and enter the hospital from the south on level 1 where the information desk is logically located, leading to the wards, the out-patient area and the cafe.

The route for visitors to the children's department, maternity ward and patient hotel in the existing complex is more unclear. Also, a lot of visitors and patients will come by themselves to the emergency reception on level 1.

A major proportion of the visitors arriving will be to these functions, and after a while, when the public has become more familiar with the complex, the traffic will subdivide into the different parts after arrival. These factors will have the effect of weakening the concept for the main entrance and main street and make these less attractive and useable.

Several vertical communications in the ward building could be combined with those in the part of the treatment wing facing the wards.

Staff

There are good conditions for the staff entrance, with car parking located in the basement. The cloakrooms are close to the entrances and there are direct lines to the different departments. For the staff working in the

existing part of the hospital there are longer but still satisfactory distances between car parking and their facilities.

4.6.4 Flow of supplies, goods and waste

Goods delivery is located in the existing part of the hospital close to the access road. The internal delivery lines are rather long, but satisfactory in a complex of this size.

4.7 Cost estimate

The following main factors have been identified as having an impact on the cost:

- size of the complex
- function
- standard
- location
- construction period
- productivity
- timing
- life-cycle cost

However, the level of technical and building solutions together with the level of medical equipment also has an impact. The strategy for management of the project, how it is organized and model for the construction contract, also have a great impact. These factors give both the cost level for the budget, and also the level of risk when the project is carried out.

4.7.1 Elements with impact on the cost

The concept and shape of the buildings will normally have an impact on the cost. The footprint of the building is subdivided and there are many corners, and the wings are mostly tailor-made for the various functions and have different dimensions and constructions. These factors give a high proportion of outer walls. Some of the building wings, such as the main entrance building, have high cost elements as large glazed walls,

however such qualities are normally necessary in large building complexes. These factors give a slightly higher cost.

There are questions associated with the mechanical rooms in the lower level. These are divided into smaller areas and are therefore large in number. It should be considered if these could be combined into fewer and bigger rooms. The central heating plant is located in the existing building complex, which gives long lines for the supply of energy.

The parking beneath the buildings and underground is expensive. The concept with a hospital structure above and a structure for parking beneath normally gives complex building solutions. The roof for the parking outside the buildings should also be capable of use by fire trucks; this gives a requirement to support heavy loads. Underground parking also requires separate escape routes and separate ventilation systems, which can be largely avoided in open parking on or above the ground.

Regarding the use of AGV (automatic transport), it should be considered if the initial investment cost gives acceptable pay-back in terms of running costs.

4.7.2 The cost figures

There are the following comments to the figures:

Contractor cost

The average cost per m² in the Sketch Project is NOK 19,953 for the hospital functions. The cost figure seems somewhat low and is at the lower end of the scale.

By comparison, the range of costs for a hospital in Norway is normally:

Low:	19,000 NOK /m ² (P50)
Middle:	25,000 NOK/m ² (P50)
High:	31,000 NOK/m ² (P50)

This is cost data from March 2009 for a full function Norwegian hospital with a gross floor area of 50.000 to 150.000 m².

General cost

The general cost, which consists of planning, administration and other costs, is 21% of the construction cost. We find this low. Normally this is between 25 and 30%, however, it is not known if there is another budget for management.

Low:	21% of Construction Cost (P50)
Middle:	29% of Construction Cost (P50)
High:	38% of Construction Cost (P50)

Reserves and margins

Reserves and margins are included at 16.5% on top of other costs (only Contractors and General cost). There is no information given on which level of risk this is meant to be. In this phase of the project, it seems to be at the lower end of the scale and therefore underestimated.

There are normally two levels of reserves and margins, P50 or P85. P50 gives 50% likelihood for final cost above budget and 50% for final cost below budget. P85 gives 85% likelihood for final cost within budget and 15% below budget.

At the sketch project stage it is normal to allow reserves and margins of:
8% - 15% for a P50 estimate on all Cost-elements
13% - 25% for a P85 estimate on all Cost-elements

Other elements

Other elements have not been considered.

Furniture

The cost for furniture seems high compared to other hospitals.

Medical technical equipment

The cost for medical technical equipment seems high compared to other hospitals.

Site works and landscaping

The cost for external works and landscaping seems high compared to other hospitals. However, there can be undisclosed cost factors that give these numbers.

Parking

The cost allowed for the parking solution in the Sketch Project seems low.

Normally Project Cost for parking under a full function hospital would be:

Low: 10,000 NOK/m² (P50)

Middle: 15,000 NOK/m² (P50)

High: 20,000 NOK/m² (P50)

Process for move

There is no cost elements included for the relocation of the functions at Fossvogur to Hringbraut, or from the existing part of Hringbraut in to the new buildings. Normally there is a need to organize the move as a separate process and include a plan for organizational change and development.

Site cost

Site cost is assumed as sunk cost and not part of the budget.

Finance cost and price increase

Finance cost and price increase is part of the total cost. This has not been considered.

Based on experience from several similar projects in Norway, many of the costs appear to be underestimated and therefore the Cost Estimate appears to be low.

The costs for renewal of the existing buildings which are to be used are not estimated, neither buildings which are to be demolished.

This is part of the overall cost and is recommended to be part of the total project cost.

4.8 Proposed adjustments to the Sketch Project

There are a few comments to the Sketch Project for a new hospital at Hringbraut within the assumptions and the building solutions for the project. These can eventually be adjusted in the next phase of the planning process.

However:

New demands as for instances building in phases and longer period between the building steps might give the conclusion that major changes are necessary.

4.8.1 Proposal for adjustments to the Sketch Project

The programme:

- Area requirements must be reviewed, particularly if the project is to be carried out in phases. It will then be important to size the first phase as correctly and appropriately as possible.
- Population base, levels of utilization and capacity requirements must be documented in more detail in relation to the current situation, and also in relation to a phased development should that become relevant.
- Area standards correspond to accepted guidelines for hospital projects generally, apart from areas for wards which should be critically reviewed.
- Area efficiency appears to be good, however potential for further improvement has been identified.

The project:

- Consider that the site on the south side of the motorway should be reserved as an area for future extension of both the hospital and university

- The location of the ambulance entrance should be considered to avoid conflict with pedestrians and the entrance to the children's department.
- A connection between the access road to the south and the junction to the east should be considered.
- Consideration should be given to locating the main entrance to the new part on level 2. The split entrances in the Sketch Project with one entrance on level 1 and one on level 2 should be avoided.
- It should be considered if the principle demands for the new part should be considered as an extension to the existing buildings rather than a new hospital adjacent to the existing.
- The following should be considered to increase generality and flexibility:
 - Change the width of the treatment and out-patient buildings to a more general building width. Consider a general width between 22 and 24m. This will increase the generality and flexibility.
 - Consider collecting the laboratories in one building, or relocate together with the treatment functions which have the same requirements for building structure.
 - Continue to develop the change of concept for the wards so that they are coordinated with the concept for the treatment building.
 - Consideration should be given to a general communication axis from south to north towards the eastern side of the complex. This will allow further development and increase the elasticity of the concept.
- Several vertical communications in the ward building could be combined with those in the part of the treatment wing facing the wards.
- Take the underground parking out of the project, consider a reduction in the number of places.
- Establish a new south–north axis for later redevelopment of the existing hospital
- Consider locating the helipad on the ground.

- Consider a more integrated building structure between the out-patient and the treatment building (but not the patient-flow)
- Reduce the number and length of culvert tunnels
- Consider integration of the wards on each level, more flexibility
- Consider the use of area in the bed wings.

Proposals for carrying out the project in phases:

- Divide the complex into more independent building elements for execution in phases
- Allow for the period between the building phases to last for a longer time

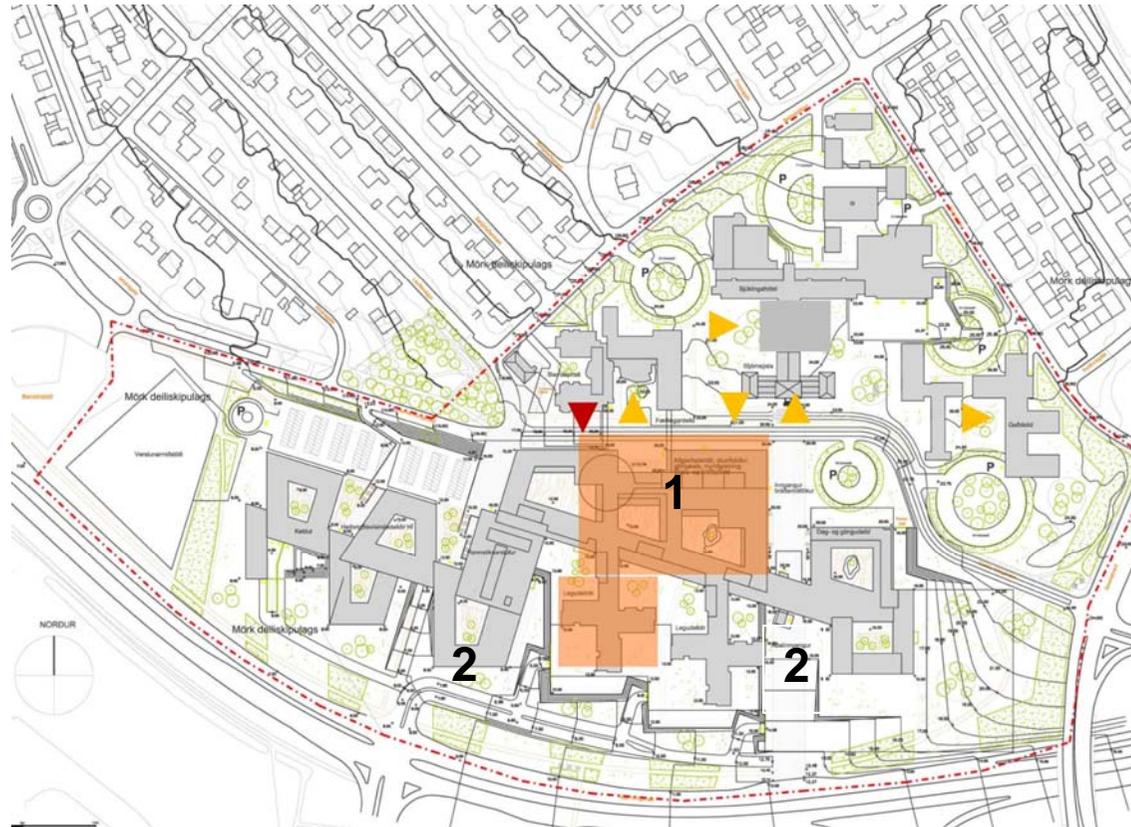
Cost estimate:

Based on experience from several similar projects in Norway, many of the costs appear to be underestimated and therefore the Cost Estimate appears to be low.

The costs for renewal of the existing buildings which are to be used are not estimated, neither buildings which are to be demolished.

This is part of the overall cost and is recommended to be part of the total project cost.

4.8.2 Proposals to increase ability for phased development



Principle Phase 1

1. Treatment building
Emergency reception
Operation
ICU
Labs.
Wards
2. Area for parking on the ground

A phased development can be commenced in the centre of the complex.. The new part can be linked by bridges to the existing children’s and woman’s departments and to the original main building. It is a goal to allow Læknagadur to still be in use in this first phase.

Phase 1 is the first step in a development with a long term perspective. The concept for phase 1 should allow the later phases to be linked to the

first phase in a natural way. The structure in the first phase should be open ended and the concept should give the opportunity to make changes in the following phases.

The concept for the overall project must have a high grade of elasticity.



Principle Further Phases

3. Treatment and out-patient building part 2
4. Wards part 2
5. Area for later renewal of the to days existing hospital
6. Axes south – north
7. University, independent of the phased development of the hospital

5 Alternative Project

5.1 Background and scope of work

The alternative is based on a scope to build only what is absolutely necessary to move the hospital functions from Fossvogur to Hringbraut, to remove bottlenecks and take out the cost effect for the running costs .

In this review the requirements have been defined as:

- 180 beds
- One operation department
- ICU
- Emergency reception
- ER combined with preliminary out-patient dept.
- Lab functions
-

The objectives for the Alternative Project have been defined as:

- Suitable for building in phases
- Improved functionality
- Reduced running cost
- Reduced investment cost
- Allow the existing university building Læknagardur to be operational as long as possible
- Phase 1 only to include functions that are “need to have” rather than “nice to have”

It is an overall and most important assumption for new buildings that the investment must optimise patient treatment and care.

5.2 Programme area

There is currently no programme for an alternative project nor a possible phase 1. As a proposal for such a programme, it is possible that a phase 1 can be about 67,000m².

The figure on the next page shows a method for preparing a programme. The crosses in the column for Alternative Project show which functions will be part of phase 1.

The main figures are:

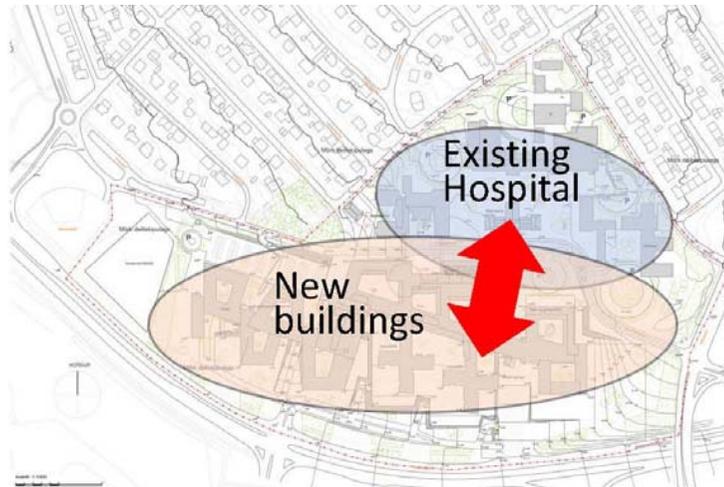
Treatment functions	45,000m ²
Laboratory	10,000m ²
Wards	8,000m ²
Patient hotel	3,000m ²
Total	66,000m ²

It is important to note that this is rough and preliminary estimate.

The following functions are proposed to be included:

- 180 beds
- One operation department
- ICU
- Emergency reception
- ER combined with preliminary out-patient dept.
- Lab functions
- Patient hotel 80 beds.
- Part of the office accommodation.

	Treatment building	Sketch Project Alternative Project		Labs		Wards		Total			
		gross	gross	gross	gross	gross	gross	gross	gross		
Level 5	OP I										
	OP II		X								
	Prepost I		X								
	Prepost II										
	Intervention Offices		reduced	Clinical labs	?	Standard					
		8 477	7400		2 370	2 370		1 975	990	12 822	11 660
Level 4	Catherisation										
	ICCU										
	Intermediate care		X								
	ICU 1		X								
	ICU2		X								
	Offices		reduced	Clinical labs	?	Standard					
		8 463	7400		2 370	2 370		1 975	990	12 808	11 660
Level 3	Rehabilitation										
	Nuclear		X								
	Radiology		X								
	Gastro		X								
	Offices		reduced			Standard					
		9 738	7400		2 370	2 370		1 975	990	14 083	11 660
Level 2	Emergency dept.		X								
	Obs. beds cluster 1		X								
	Obs. beds cluster 2		X								
	Available										
	Offices		reduced	Clinical labs	?	Standard					
		9 900	7400		2 370	2 370		1 975	990	14 245	11 660
Level 1	Pathology		X								
	Bleed unit		?								
	Sterilization		X								
	Rehabilitation out-p										
	Blood sampling										
	Cafeteria		? reduced								
	Cafe					Standard					
		9 755	7400					1 975	990	11 730	9 290
Level 0	Pathology		X								
	Medical devices		?								
	Bed central		?								
	Hospital Pharmacy		X								
	Textile services		X								
	Cloakrooms		reduced								
	IT					Standard					
		9 935	7400					1 975	990	11 910	9 290
Level U1	Mechanical		X			Mechanical					
	Cloakrooms		reduced			Cloakrooms					
		8 070						1 115	1060	9 185	1060
Total Building		72 295	44 400		9 745	9 745		15 093	7000	97 133	



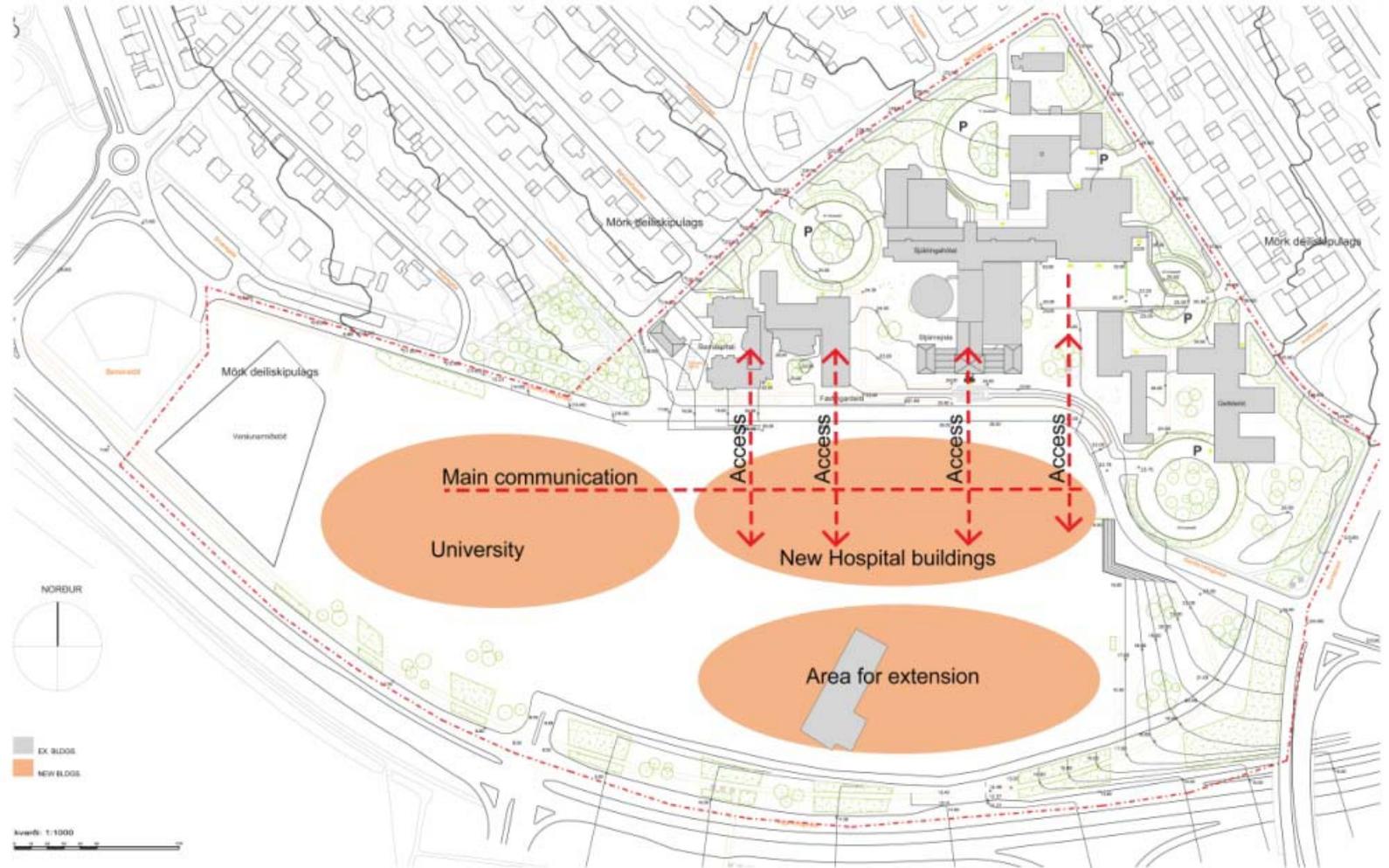
Principle illustration showing improved relationship between existing and new parts of the hospital

5.3 Development plan

In the alternative development plan it is considered that the first step should be as closely connected to the existing hospital as possible. Also, as much as possible of the areas in the new building shall have good access possibilities to the functions in the existing buildings. This allows medical functions, that have a requirement for close connection, to be shared between the existing and new part.

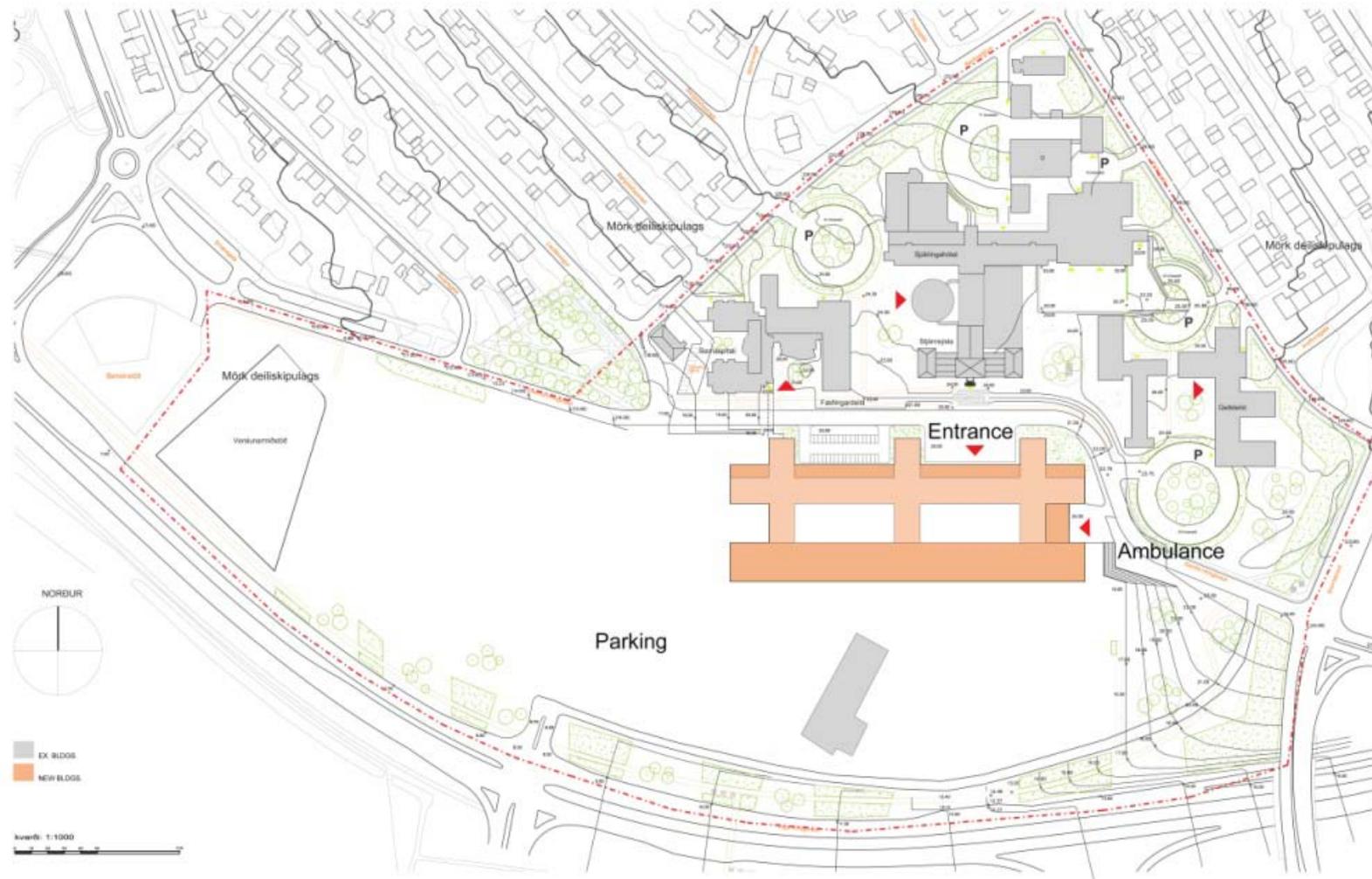
It has also been a requirement that the following steps should give the opportunity for the hospital to meet the full future needs of the population. This means that the first step must have a high grade of elasticity, be able to be extended in various places and with steps of different sizes.

The alternative also proposes to locate the university to the west, and to strengthen the axis from south to north. The more compact solution also allows Læknagardur a free situation.



Alternative Concept - principle

Notice: The illustrations for the Alternative Project represent a principle design and disposition; they do not represent buildings at the same stage of development as in the Sketch Project.



5.4

Alternative Project phase 1

5.5 Site plan

The first step is located at the central point to achieve close connections between the new building and existing hospital. The main entrance is on level 2 with direct access from the internal road, and is located opposite the original main building. The entrance leads directly in to the east–west axis in the new complex.

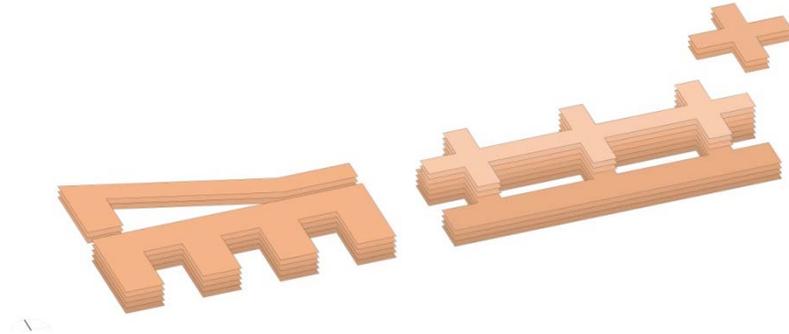
The proposed internal road in the Sketch Project is retained as a part of the site plan.

Connections between the new building and children’s and woman’s departments can be established as in the Sketch Project, as well via underground culvert tunnels.



Principle cross section

5.6 Phase 1



Alternative Project - perspective building volumes

The building concept is shown with a general building width of 24m, and there are enough areas with sufficient daylight for all the working places. The wards are proposed located on levels 4, 5 and 6 in 3 wings. The concept for each ward is the same as in the Sketch Project, but the wings are linked together. The Patient hotel can be part of the ward building as a preliminary solution.

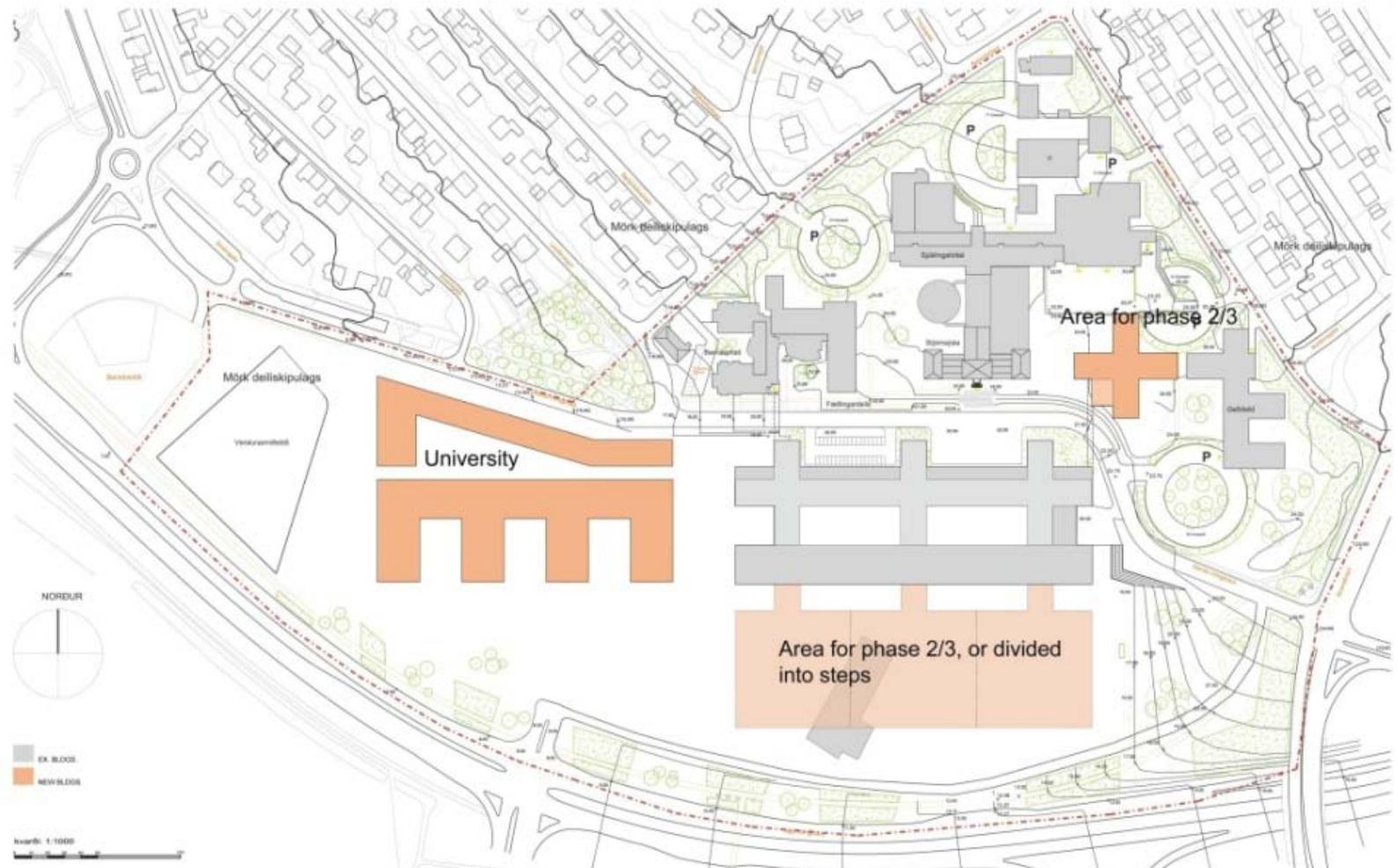
The emergency reception and the entrance for ambulances are proposed in the eastern part with direct connection to the motorway road junction. It is also possible for ambulances to use the internal road in order to exit towards the west. A helipad is assumed located on the ground, or alternatively could be established on the roof of the first phase as proposed in the Sketch Project.

The catheterisation and operation theatre for day surgery can be located in the original main building as a preliminary solution to the next phase.

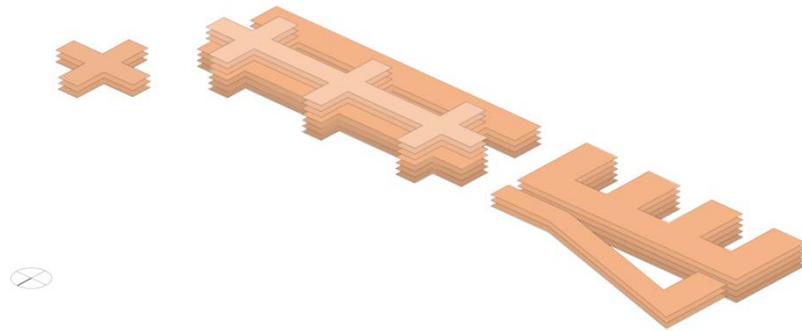
A helipad towards the eastern side of the complex may give less noise disruption to the rest of the hospital.

How and where the other different functions are located in the building has not been considered in detail.

5.7 Phase 2 – 3 and the University



Alternative Project Phase 2/3 and University

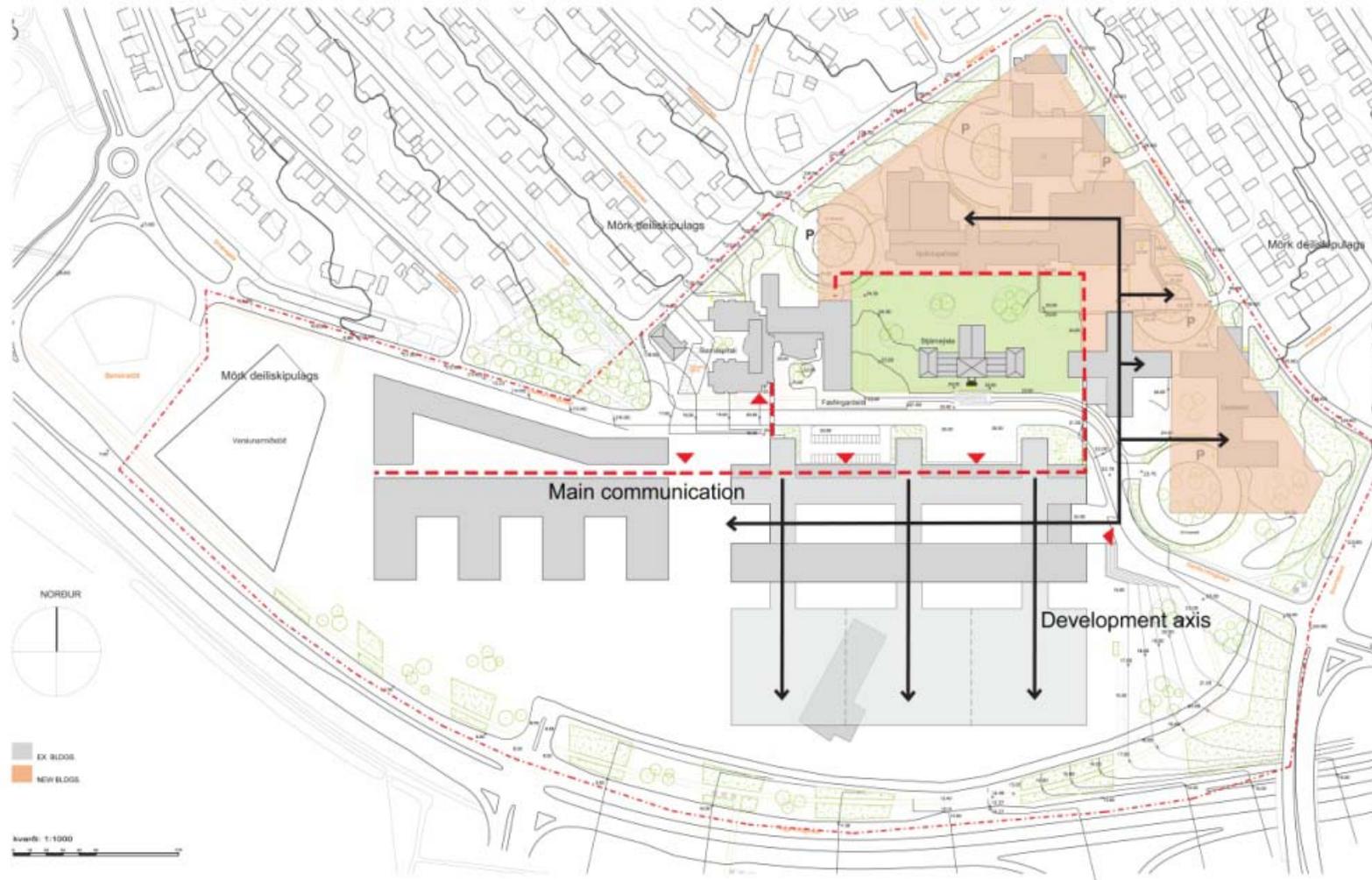


*Alternative Project - perspective building volumes
The University part in front. Phase 2 or 3
of the Hospital is not in the illustration*

Further phases can be carried out as extensions to the south, extending the treatment building, and to the north east where it is possible to replace the existing nursing school, an old and inefficient building, with a new hospital building. This could either be a new wing for wards, or accommodate other treatment functions.

An extension of the treatment building to the south can be carried out in large steps each including many treatment or medical services, or in smaller steps more suited to extending the separate functions accommodated within the already established treatment building.

5.8 Further development and renewal



Alternative Project - Concept

The goal for the conceptual structure is to establish high grade of both generality and elasticity. It is important that later extensions or phases in the development of the hospital can be planned and built in accordance with future needs, which of course remain unknown for us today.

The Alternative Project gives the freedom to establish many alternatives for further future development.

In a long term perspective, over some generations, it is possible to carry out further renewal and construct new buildings on the northern side of the original main building. The internal main communication route can be planned as an inner circle around this building, and act as a starting point for new development axes extending outwards into new parts of the site.

The Alternative Project elevates the status of the original main building to be the “jewel in the park”. In the first phase the building will probably have to be used for medical functions, but in a longer perspective it could be a social or conference centre in addition to accommodating offices for the administration.

5.9 Time schedule and construction sequences

The conceptual structure gives the opportunity to choose freely the appropriate construction sequences and time schedules, with few constrictions dictated by earlier already completed steps.

5.10 Parking



Possibilities for parking

- 1 *Underground parking under the entrance plaza, approx. 1,200 cars on 2 levels*
- 2 *Parking on the ground, early phases.*
- 3 *Possible parking in lower levels in new building*
- 4 *Parking on the ground, or multi-storey car parks, for staff*

Parking can be provided in different ways. The strategy in the first phases is to use areas of un-built ground for parking.

Alternative 1 is an option for parking solutions. The underground alternative is expensive but gives a satisfactory number of parking spaces close to the main entrance and the children's and women's departments. A project placed at this location should be carried as independently as possible of the existing hospital nearby. However there are a number of complicated factors that have to be taken into consideration in any eventual further process.

6 The 0-Alternative: comparison between strategies

6.1 Background and Scope of Work

This report considers different alternatives for the development of the hospital, including different solutions and different strategies to allow commencement of the development. This also includes consideration of a phased development. The background for this is first and foremost the challenges facing the hospital in financing a large building development in the current economic climate.

In order to illustrate the consequences of the different alternatives and strategies for commencement, an economic comparison of the alternatives has been carried out in which the present day economic value of the investment is considered along with operational cost consequences. In addition, consideration is given to consequences and issues which cannot easily be quantified in economic terms. This mainly relates to qualitative issues.

It is important to note that the economic comparison is not a complete analysis of directly comparable alternative solutions, and that it is chiefly concerned with comparisons of alternative strategies. Once the chosen strategy has been established it may be beneficial to carry out a more detailed comparison of such directly comparable alternative solutions, however this lies outside the scope of this commission.

One of the present strategies for addressing the hospital's requirement for improved facilities, is to maintain the hospital's existing facilities by keeping these at a minimum level in terms of quality and capacity. This is known as the *0-Alternative*.

6.2 Definition of 0-Alternative

The 0-Alternative does not simply consist of “doing nothing” – an option which is unrealistic both economically and in terms of qualitative considerations. The 0-Alternative also includes improvements and development proposals, which are described more fully below.

In Norway, there is a requirement to consider a 0-alternative when carrying out hospital planning projects or indeed any other large scale public sector developments. To illustrate our understanding of the definition of a 0-alternative, we refer to the following text from *Prosjekt nytt Østfoldsykehus*, where this is described in detail:

Logikken i 0-Alternativet følger Finansdepartementets krav om at 0-alternativet skal innbefatte "de vedlikeholdsinvesteringer og oppgraderinger som er nødvendige for at alternativet skal være reelt". Styringsgruppen har vurdert om tidsperspektivet i 0-alternativet skulle være det samme som for de øvrige alternativene (diskontingering til nåverdier basert på 40 år). Det ble konkludert med at for 0-alternativet beskrives tiltak med et tidsperspektiv til 2020, dvs. 15 år. I et 40-års perspektiv ville 0-alternativet i hovedsak bli som alternativ 1A. Tidsperspektiv til 2020 innebærer at man "avskriver" investeringene på 15 år. Dersom driften fortsetter på samme tomt, vil imidlertid noen av investeringene ha en restverdi etter 15 år, mens man ved å åpne et nytt anlegg om 15 år ikke vil få noe vesentlig igjen for investeringene i 0-alternativet. Derfor er tidsperspektivet i noen grad avhengig av hva som skjer etter 2020. I tillegg kan man si at dersom man med absolutt sikkerhet kunne slå fast at et nytt anlegg ville være klart til innflytting i 2020, kan det være at noen av investeringene i 0-alternativet kunne skyves på, og dermed til slutt unngås. I en slik strategi ligger det også en risiko for at man akutt og dermed med vesentlig ekstra omkostninger må gjennomføre omfattende tiltak pga. sammenbrudd eller pålegg.

It should be noted that the years and periods discussed in this definition for Nytt Østfoldsykehus are utilised only in part in this report, however the alterations are modest.

The building work involved in the 0-Alternative includes the following three categories:

- Necessary refurbishment and maintenance to ensure technical installations and building fabric are kept to an acceptable minimal standard, both qualitatively and economically.

- Building alterations and installations to incorporate necessary changes, both functional and technical.
- Expansion of capacity to meet increasing demands. It should be noted that such expansion should be planned at a minimum level in order to avoid the most unacceptable bottle necks.

Examples of types of measures which are not, or only to a limited extent, included in a 0-alternative are also mentioned:

- Building extension or alteration in order to improve quality of patient environment, for example rebuilding to create only single bed units.
- Building extension or alteration in order to improve operational efficiency, for example the combination of emergency functions and laboratories.

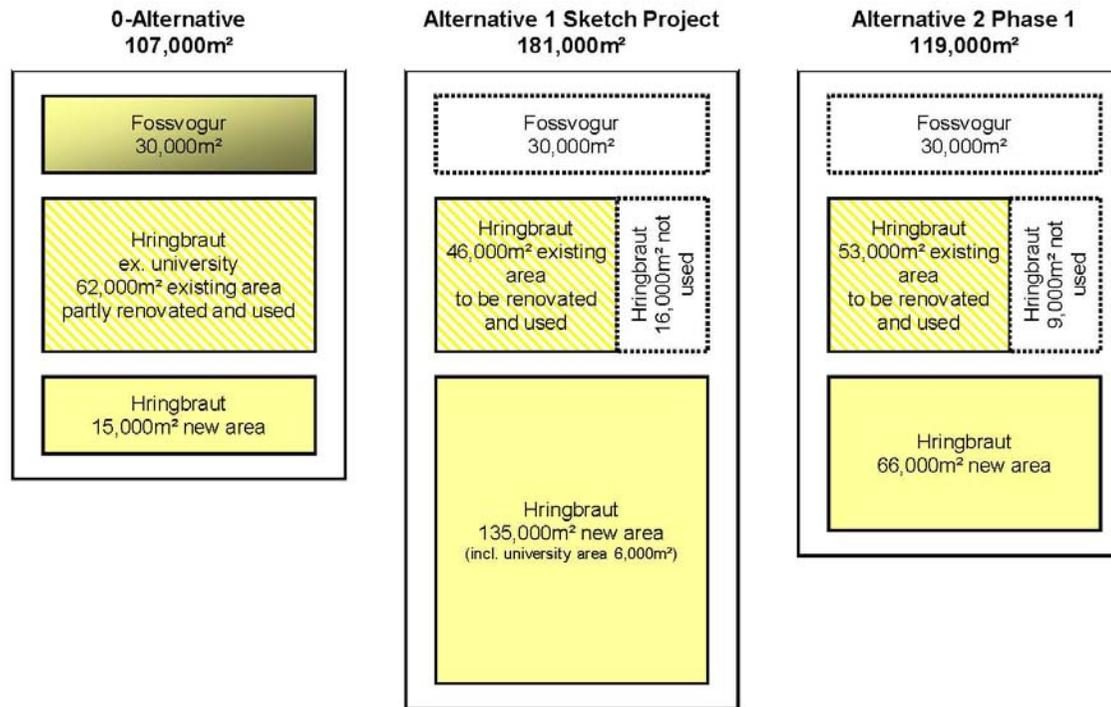
The hospital's Estate Department has in its possession extensive documentation indicating the kind of work which should be undertaken on individual buildings, when it should be undertaken, and the associated and consequential costs. Such documentation is not included in this report and exists rather as issued enclosures, ref. *Viðhalds- og endurnýjunarþörf bráðadeilda og rannsóknastofa LSH 2010-2025*, dated 28.11.08.

6.3 Alternatives and strategies to be compared

The following alternative strategies are to be compared against one another:

- 0-Alternative: Maintain current facilities at an acceptable minimum level, either as a long term solution, or as a stop gap in anticipation of a future and more long term, extensive development.
- Alternative 1: A complete redevelopment in accordance with the development proposal and scope as described in the Sketch Project, possibly also incorporating the minor alterations as discussed in this report, including a critical review of the capacity and area requirements. A prerequisite is the realisation of an 80 bed patient hotel within the given area and cost framework.
- Alternative 2: The construction of a first phase, either in accordance with the Sketch Project's development concept, or in accordance with an alternative concept as described in this report. The principle governing this first phase must be to carry out a development which, on the one hand, is achievable and has a realistic scope, and on the other, provides most of the economic and qualitative advantages which can be expected of such a development. A prerequisite is the realisation of an 80 bed patient hotel within the given area and cost framework.

These alternatives can be illustrated simply as below:



The 0-Alternative utilises the existing facilities at Fossvogur in their entirety, together with 62,000m² of the hospital's general building mass. The existing areas are upgraded in accordance with the definition of the 0-Alternative. 15,000m² new build are provided to replace poor quality existing buildings and to provide an absolutely necessary increase in capacity.

Alternative 1 is in accordance with the Sketch Project. 135,000m² new build inclusive of 6,000m² university areas which are integrated with the clinical areas. In addition, re-use of 46,000m² existing areas, which are to

be upgraded as in the 0-Alternative. Fossvogur and other general areas are either disposed of or utilised for hospital functions.

Alternative 2 is a first phase development of 66,000m² new build plus re-use of 53,000m² existing area upgraded in accordance with the 0-Alternative. The objective is to realise as much as possible of the economic advantages of a redevelopment. In addition, this alternative also includes a series of qualitative improvements, such as providing single rooms for approximately 180 beds, and creates a platform for further development in several directions.

6.4 Input to the economic analysis

Input to the economic analysis is as illustrated above in terms of extent of new build areas and upgraded existing areas in the three alternatives.

The analysis also takes into account the study carried out by the hospital into economic consequences of ongoing operation, ref. memo of 28.11.08, *Excess operational cost of somatic units at Hringbraut and Fossvogur*, plus a specific review carried out with the Estate Department of the timing and scope of renovation of existing facilities. Finally, the extent of facility management costs has also been clarified with the Estate Department.

In addition to the above mentioned documents, input to the economic analysis can be summarized as follows:

Basic assumptions:

- Cost reference date: March 2009;
- New facilities project cost 609,000 ISK/m² (incl. equipment costs, excl. parking);
- Life span of analysis: 40 years;
- Life span of investment: 40 years;
- Rest value at 2049: 10/40 in Alt.1; 8/40 in Alt.2; 0 in Alt.0. No rest value estimated for existing buildings;
- Discount rates 3, 4 and 6%;
- Project cut off for Alternative 0: 2019 (new buildings);
- Project cut off for Alternative 1: 2019 (new buildings);
- Project cut off for Alternative 2: 2017 (new buildings);
- Timescale rebuilding Alternative 0: High intensity 2016-2025;
- Timescale rebuilding Alternative 1: 2020-2023 and 2030-2033;
- Timescale rebuilding Alternative 2: 2018-2021 and 2028-2031;
- Sale value of existing facilities: 7,500 million ISK;
- Gains in operating costs due to new facilities: According to text in memo dated 28.11.2008, and e-mail dated 31.03.09;
- Variance in FM costs existing vs. new facilities: Estimated extra costs at an average 8,500 ISK/m². On the margin 80% of average FM cost/m² in Alternative 1 and 90% of average FM cost/m² in Alternative 2;
- Main reinvestment point of time in Alternative 0: Not estimated (implicit assumption 2050).

6.5 Result of the analysis: comparison between strategies

All input data is included on a spreadsheet for each of the three alternatives, where investment and operational economic consequences are extrapolated to current values. The spreadsheets are available to the client, but are not attached in printed form to this report.

The result (Net present value - NPV) of the economic analysis is summarized in the table below, expressed in billion ISK:

Discount rate	Alternative 0	Alternative 1	Alternative 2
6%	-16	-38	-8
4%	-20	-35	-1
3%	-23	-29	+ 4

This has the following implications for the economic analysis and for the more qualitative considerations of the strategies:

0-Alternative: Negative NPV in the order of -16 to -23 billion ISK (depending on discount rate).

It should be noted that the investment requirement is also large, around 30 billion ISK, in order to maintain minimum standards of buildings and capacity. This is such an extensive investment that it will largely prohibit investment in new hospital facilities for the foreseeable future.

This alternative brings the building fabric and technical standards up to a qualitative and economically justifiable minimum level, but provides very limited or no positive effect on qualitative issues such as patient and working environments, potential for increased economic efficiency, possibilities for new working methods and new medical techniques, possibilities for closer cooperation and professional development between the hospital and the university.

In a hospital with significant responsibility for the whole nation's health service, this will in future years be regarded as a serious omission and a restriction to further development of the country's health service.

Alternative 1: Negative NPV in the order of -38 to -29 billion ISK. A main factor for a negative NPV is that the project is

large in area, with a large investment requirement and significant FM costs.

Investment requirements are estimated at 90 billion ISK, and are of an order which would be difficult to achieve in the current economic climate.

The advantage, however, is that a complete redevelopment gives all the possibilities for creating the most efficient operation, both by combining existing doubled up functions, and by more easily being able to implement new working methods, utilise new equipment, etc.

Furthermore, complete redevelopment provides a significantly better environment for both patients and staff, such as single-bed rooms for all patients. This in turn also contributes to more efficient and qualitatively improved clinical activity.

Complete redevelopment also allows for significantly closer cooperation between the hospital and the university, with advantages for education and research, and the development of new methods and techniques, etc.

It should be noted that this report focuses on the possibility for making improvements to the Sketch Project, so that the operational economic possibilities can be achieved in an even better manner.

Alternative 2: Negative NPV in the order of -8 to + 4 billion ISK, and is therefore the best of the current strategies in economic terms.

Investment requirements are significantly lower than for Alternative 1, and are estimated at 51 billion ISK.

At the same time, this alternative will be able to achieve nearly the same operational economic advantages as Alternative 1, particularly as the doubled up functions can be combined and new working methods and new techniques can more easily be implemented in new treatment areas. The advantages will not quite match those of Alternative 1 as significant parts of the hospital will continue to be run in existing and less satisfactory buildings.

For patients and staff there will be a significant improvement in the physical environment, and closer cooperation will be made possible between the hospital and the university.

6.6 Possibilities for achieving operational economic advantages

An important theme in the hospital's development work has been to increase its operational efficiency. The current situation is marred by a series of doubled up functions, complicated and non rational operations in many areas. A continued focus on this theme has also been important in preparing this report.

In Norwegian hospital projects carried out during the last few years, operational economic advantages have been calculated to around 5-7% of the annual running costs. This is the equivalent to the effect which can be calculated directly as a result of new and more efficient facilities. Alternatives 1 and 2 in this report have an operational economic advantage calculated to 2.8 and 2.4 billion ISK per year respectively, equalent to 7,2 % and 6 % of running costs.

The main advantage of investing in new facilities, however, lies possibly in an area which is more difficult to quantify, but nonetheless has significant potential:

A prerequisite to be able to plan and carry out a large investment is to, at the same time, plan and implement a new organization with more efficient operation.

Put another way:

one does not build new buildings for old organizations!

The planning and in part implementation of a new organization can start now, and a large portion of the advantages can be realized before a new building is taken into use.

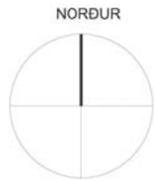
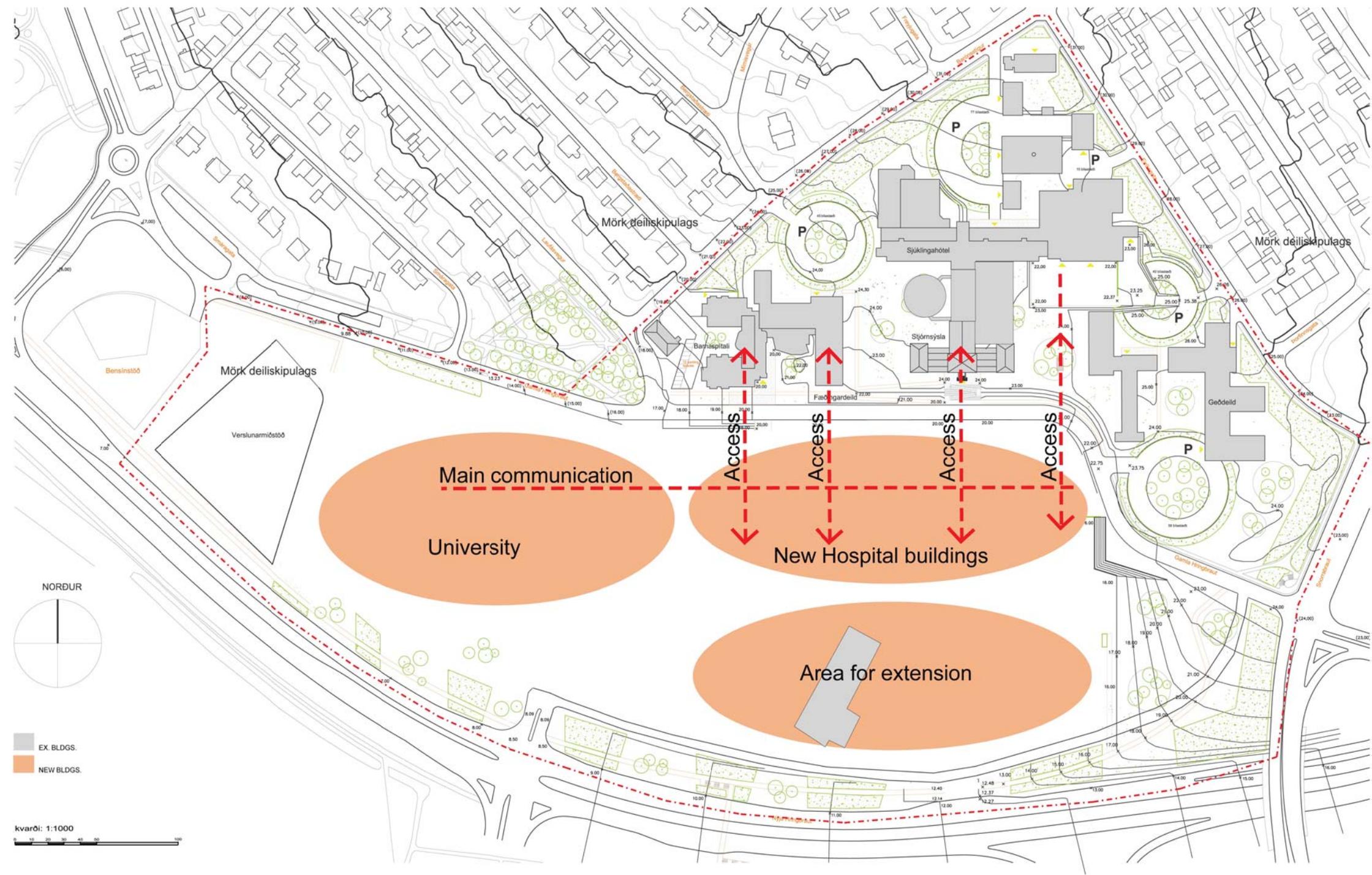
In order to achieve this, it is paramount that the organization is certain that it is to move into new premises, and this in itself is a powerful stimulant for organizational development.

Put another way: new premises are an important stimulant and incentive to develop and increase efficiency in an organization!

These indirect effects of a new building are not estimated or quantified in this report, as they are not a direct result of new facilities. The value of these effects should however be given importance when considering the alternative development strategies.

6.7 Appendix:

Alternative Project Phase 1
Alternative Project Phase 2 - 3 and University
Alternative Project Cross section
Alternative Project Further renewal
Alternative Project Main communication and development axis
Alternative Project Parking
Alternative Project Typical Level 0-1
Alternative Project Typical Level 2
Alternative Project Typical Level 3
Alternative Project Typical Level 4-6
Alternative Project Perspektiv building volumes 1
Alternative Project Perspektiv building volumes 2



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NEW BLDGS.

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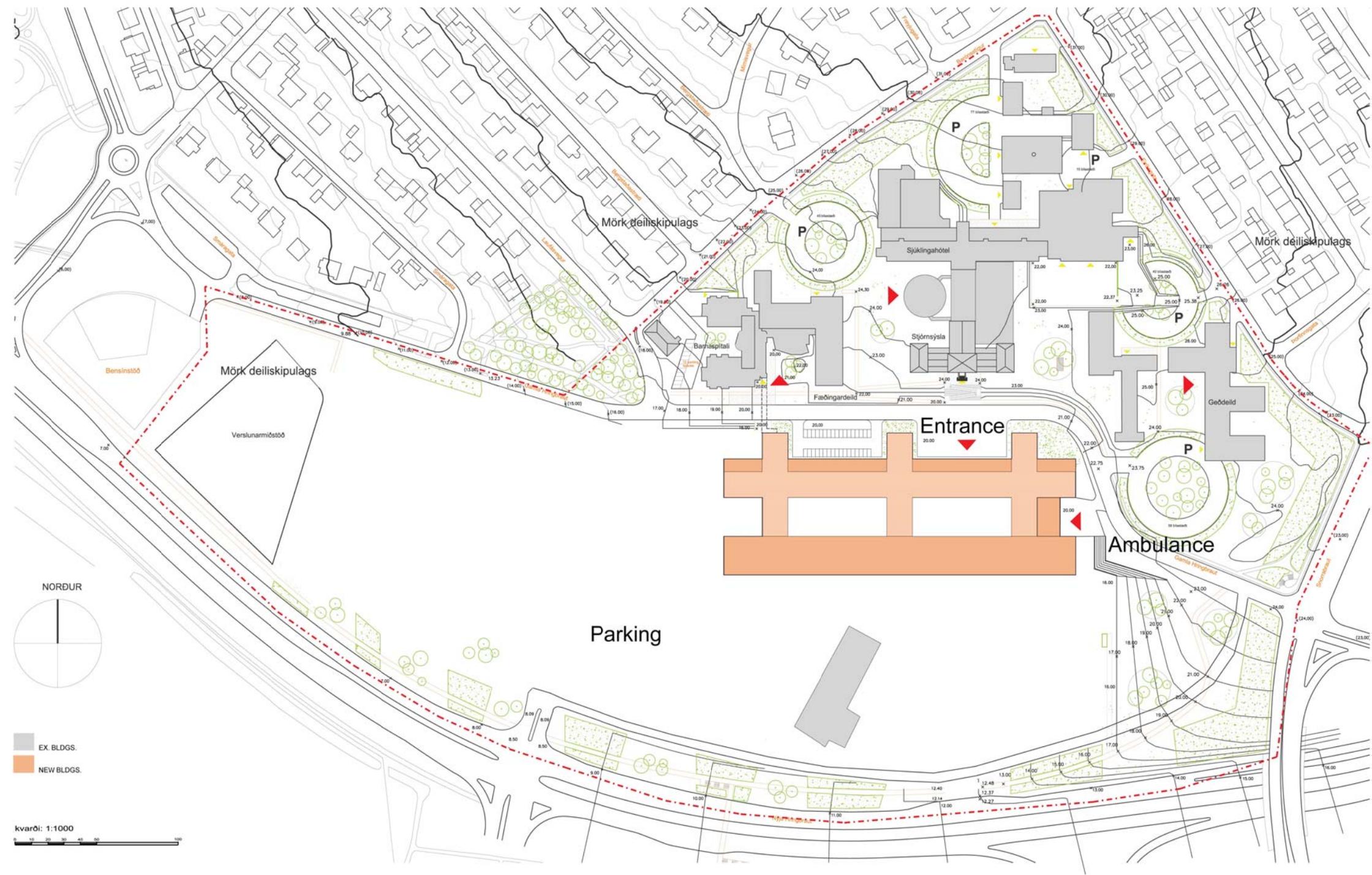


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Alternative Concept





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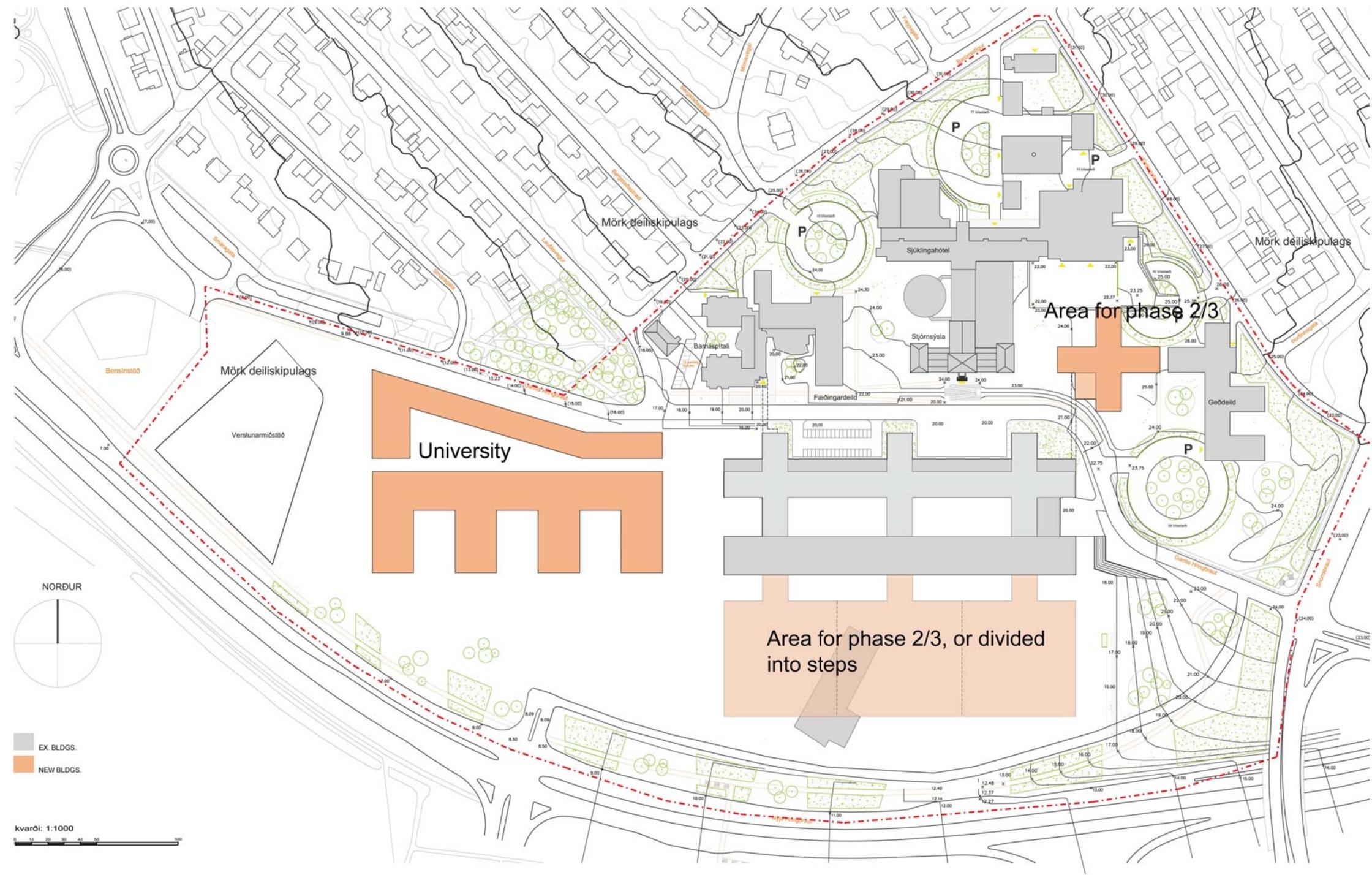


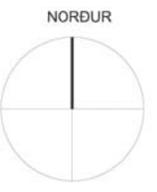
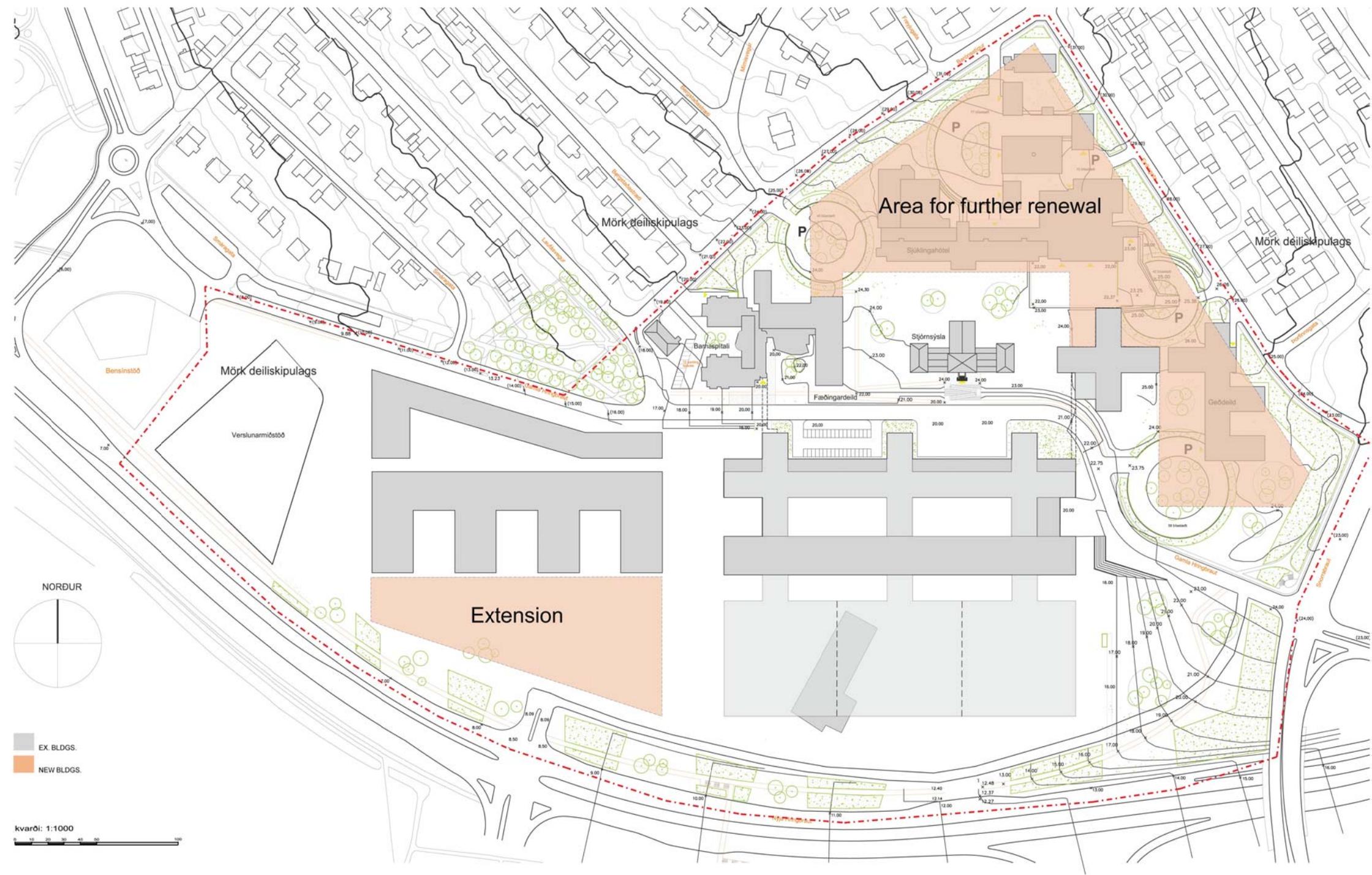
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Landspítali Reykjavík Review of planned development
Alternative Phase 1







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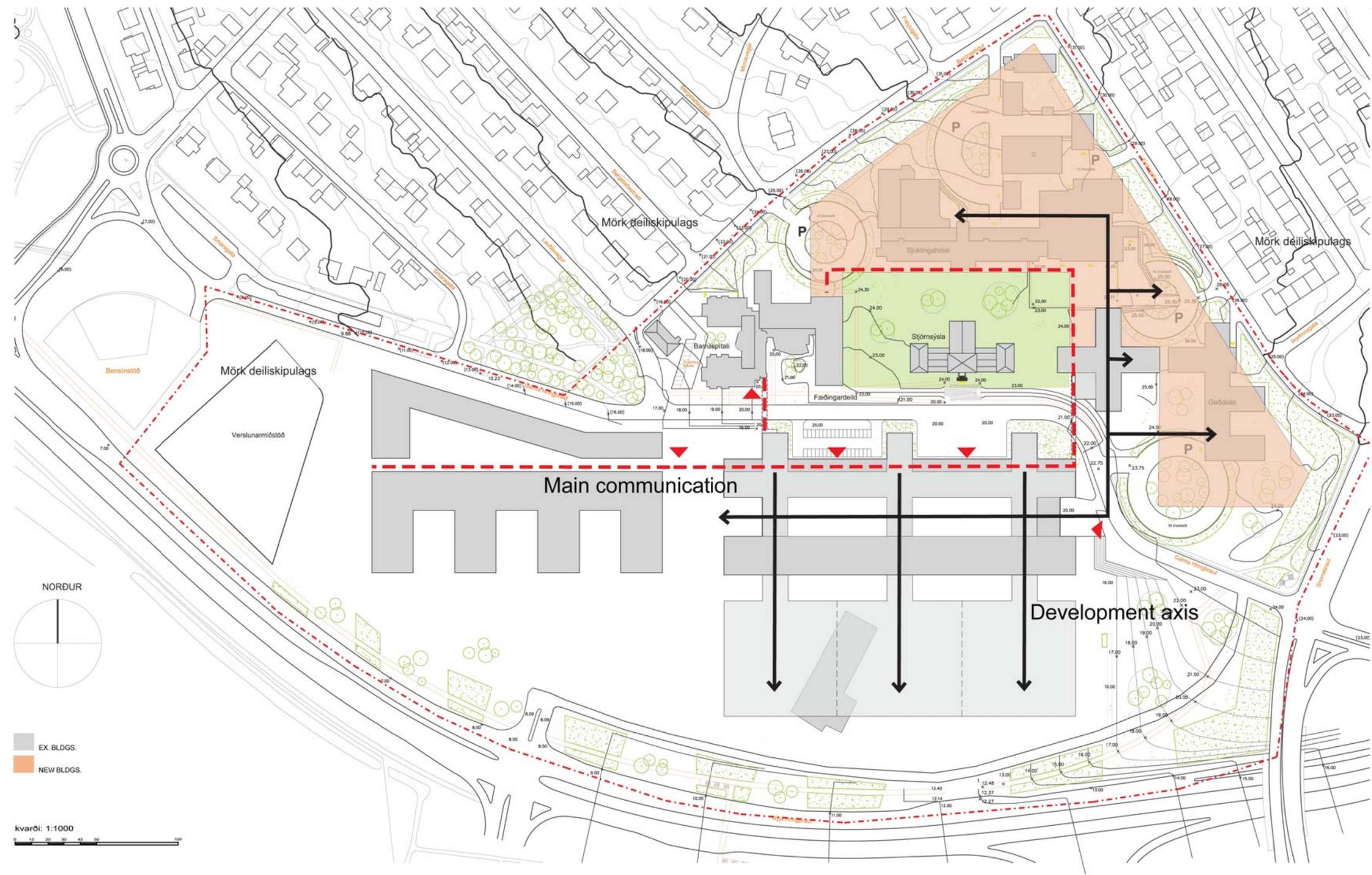


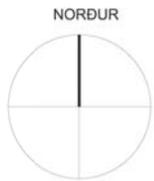
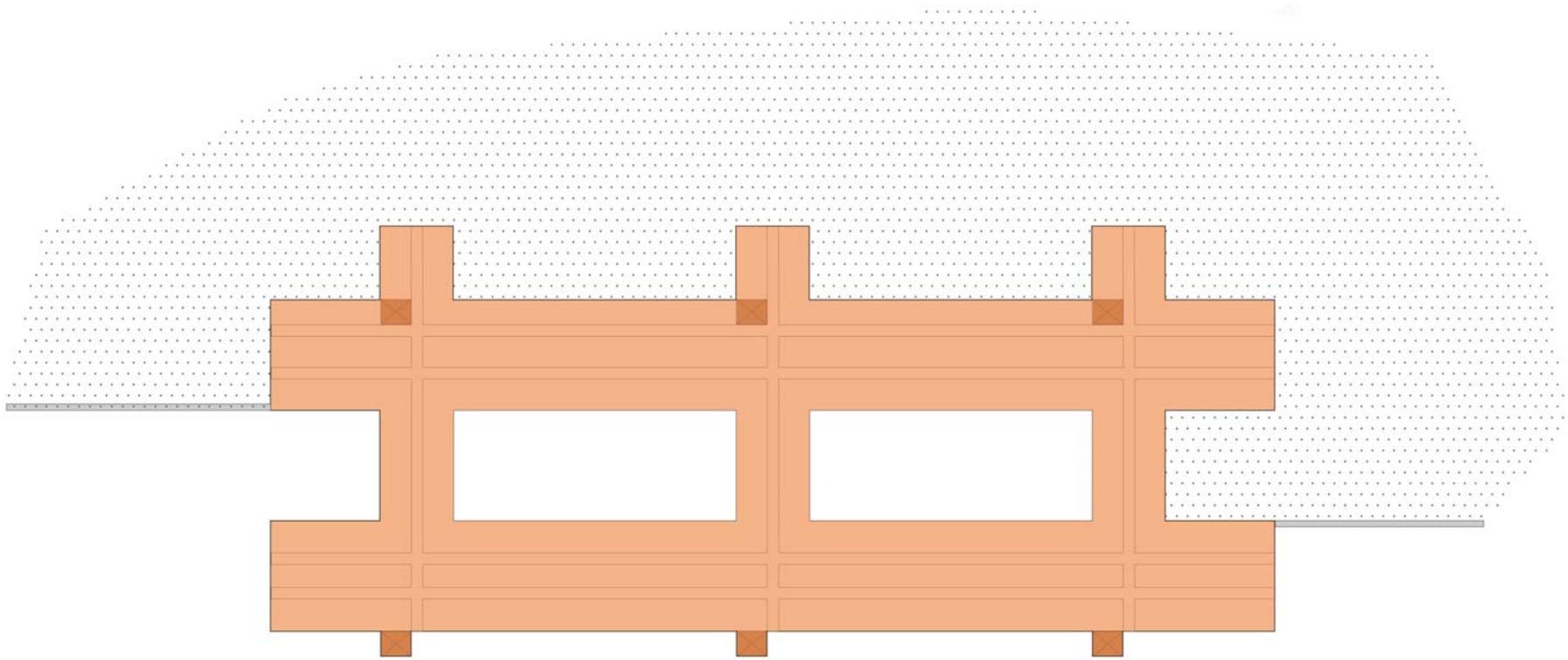
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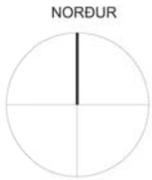
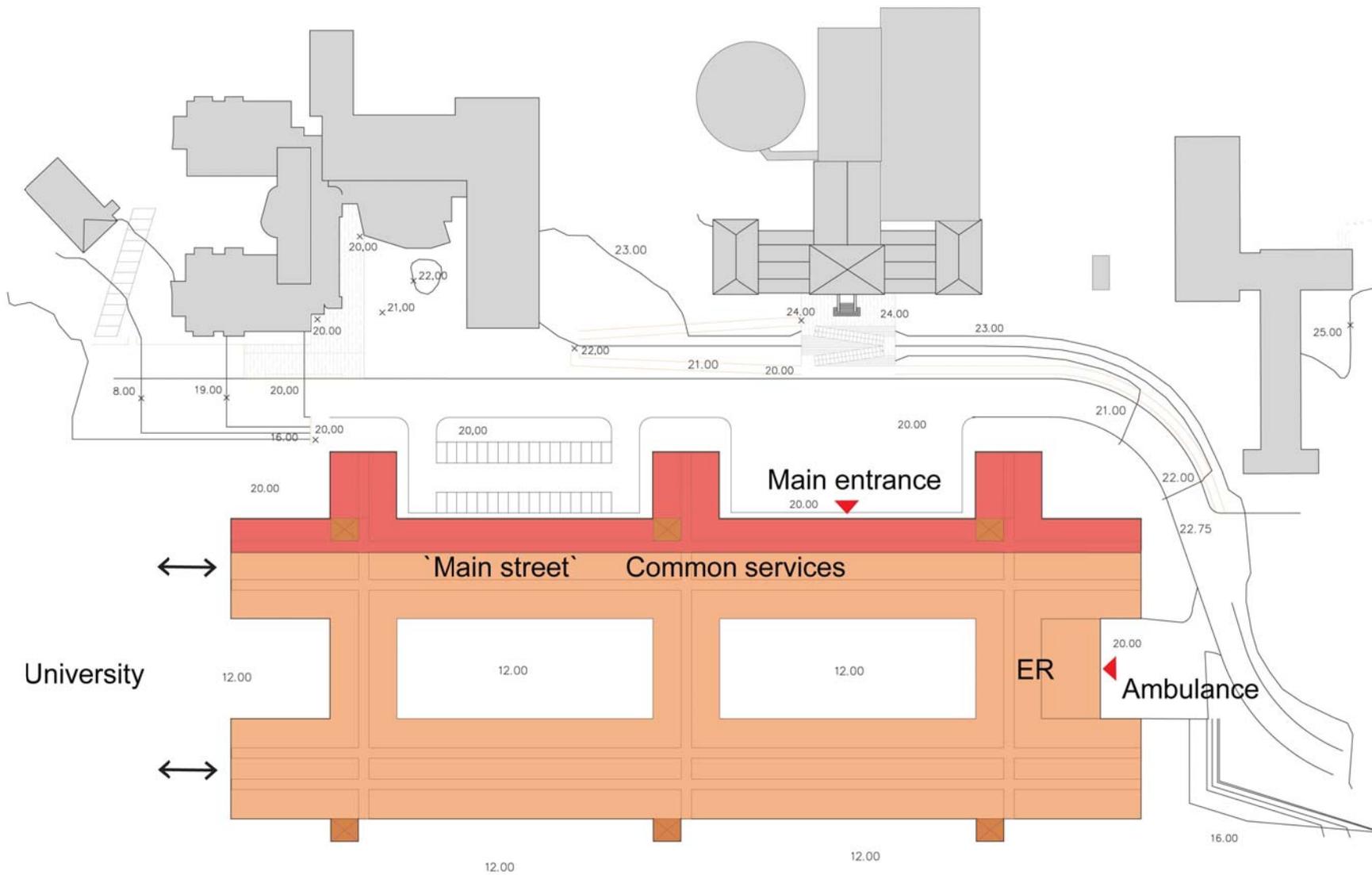
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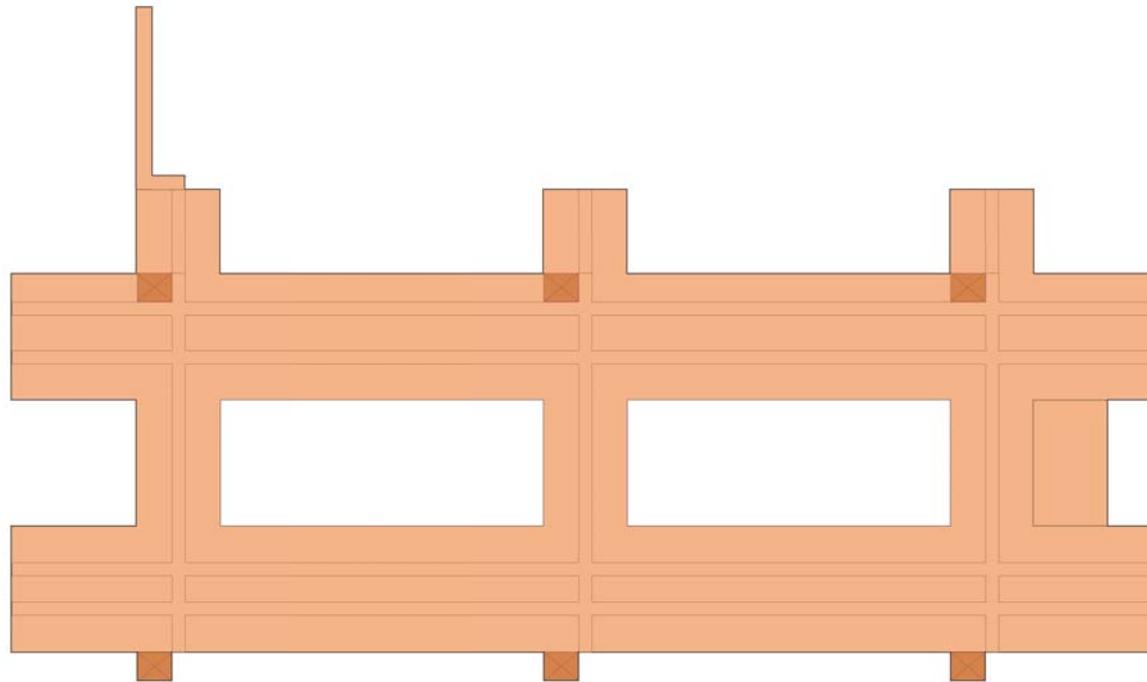
Landspítali Reykjavík Review of planned development
Alternative Further renewal and extensions

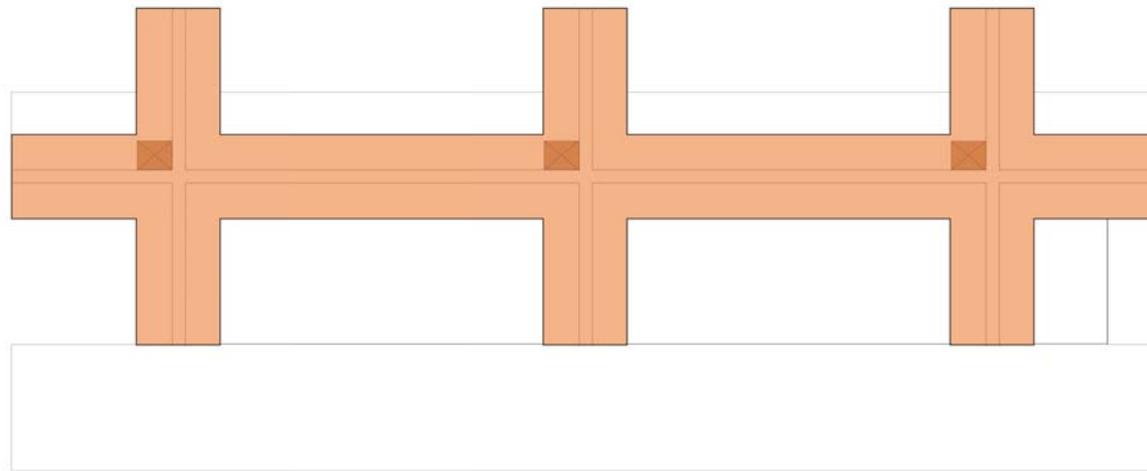


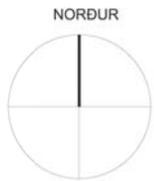
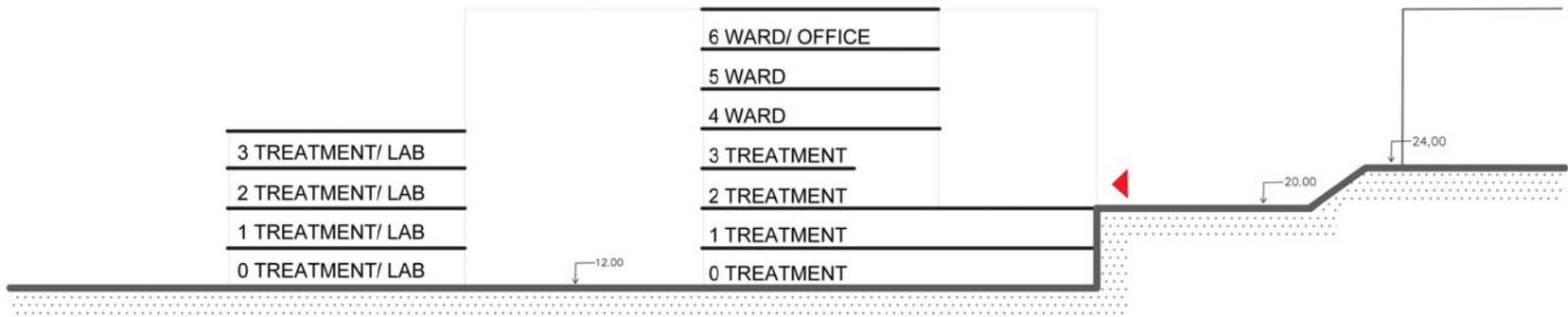












1. Underground parking
appr. 1200 cars in two levels
2. Parking on ground
in early phases
3. Parking in lower levels
in later phases
4. Parking on ground
for employees

