

SPECIAL REPORT

OF THE

DELHI TOWN PLANNING COMMITTEE

ON THE

**POSSIBILITY OF BUILDING THE IMPERIAL
CAPITAL ON THE NORTH SITE**



DELHI
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CONTENTS OF THE REPORT ON THE NORTH SITE.

Paragraph.	Page.
1 THE PREVIOUS CONSIDERATION OF THE NORTH SITE BY THE COMMITTEE	1
2. REVIVAL OF INTEREST IN THE NORTH SITE	<i>ib.</i>
3. REASON FOR RECONSIDERATION OF THE NORTH SITE	2
4. THE POSSIBILITY OF REDUCING THE AREA REQUIRED FOR THE NEW CITY	<i>ib.</i>
5. THE AREA AVAILABLE FOR THE NEW CITY ON THE NORTH SITE	3
(a) Area subject to flood	<i>ib.</i>
(b) Area irrigated by the Western Jumna Canal	<i>ib.</i>
(c) The Civil Lines	<i>ib.</i>
(d) The <i>Bela</i>	<i>ib.</i>
6. SPECIAL POINTS IN CONNECTION WITH THE NORTH SITE	4
(a) Cost and result of purchase of Civil Lines	<i>ib.</i>
(b) Difficulties about the treatment of areas west of the ridge	<i>ib.</i>
(i) The Najafgarh Drain	<i>ib.</i>
(ii) Low-lying land	<i>ib.</i>
(iii) Sewage disposal	<i>ib.</i>
7. GENERAL POINTS IN CONNECTION WITH THE NORTH SITE	5
(a) The question of room for expansion more vital than ephemeral amenities	<i>ib.</i>
(b) The initial cost of the ground	<i>ib.</i>
(c) The provision for Cantonments	<i>ib.</i>
(d) The provision of land for recreation	<i>ib.</i>
(e) The narrowing of ideals	<i>ib.</i>
8. PLANNING ON THE NORTH SITE	<i>ib.</i>
Scenic aspect from the North Ridge	6
9. COMPARISON OF COST OF A CITY ON THE NORTH SITE WITH A CITY ON THE SOUTH SITE	<i>ib.</i>
10. A BRIEF DISCUSSION OF SIR BRADFORD LESLIE'S SCHEME	<i>ib.</i>
11. CONCLUSIONS IN REGARD TO THE NORTH SITE	7

APPENDIX.

Detailed discussion of Sir Bradford Leslie's scheme.

MAP.

Map showing the levels of low-lying area and tract suitable for building upon. Scale 2"=1 mile.

To

HIS EXCELLENCY THE VICEROY
AND GOVERNOR-GENERAL OF INDIA.

11th March 1913.

YOUR EXCELLENCY,

In accordance with instructions received from Your Excellency I have the honour to present a special report of the Delhi Town Planning Committee on the possibility of building the Imperial Capital on the North Site.

I have the honour to be,

Your Excellency's obedient servant,

GEORGE S. C. SWINTON, *Captain,*
Chairman, Delhi Town Planning Committee.

REPORT ON THE NORTH SITE BY THE DELHI TOWN PLANNING COMMITTEE.

1. The chief considerations which the Committee had in view in choosing a site for the new capital, are set forth in paragraph 2 of their report of the 13th of June 1912 on the choice of a site for the New Imperial Capital at Delhi. The new city was to be located in an area in close physical and general association with the present city of Delhi and the Delhis of the past. The Committee understood that it was to be a capital in the true sense of the word, and that its development was to be a fulfilment of the Royal decision regarding the transfer of the seat of the Government of India from Calcutta to the ancient Capital of India. The Committee was informed that it was possible that the residence of the Government of India in the future at Delhi might extend to seven months of the year. The Government of India had placed their requirements, after due enquiry, at 10 square miles for the new city and 15 square miles for the cantonment. It was therefore essential to choose a large site near Delhi with ample room for expansion. It was above all necessary to choose a healthy site on which sanitary needs could be safeguarded at a moderate cost. In a seven months' residence at Delhi the fact that one month of the autumn in certain localities is malarious and one month of the spring is hot have to be faced and met. The north site, often called the Durbar area, was carefully weighed in the balance by the test of these governing conditions by the Committee last summer and found wanting. The conclusions of the Committee in regard to it, which are summed up in paragraph 7 of their report, were to the effect that a healthy capital city to be laid out on a large scale in this area and to be occupied for seven months of the year was impossible save at vast expense.

The previous consideration of the north site by the Committee.

2. Shortly after the return of the Committee to India at the close of 1912, public attention was directed to the north site. On the 12th of December 1912, Sir Bradford Leslie, an engineer with a distinguished Indian career, read a paper before the Indian section of the Royal Society of Arts in London, in which he set forth plans for building the new capital on the northern site and producing a fine water effect by a treatment of the river Jumna. This paper aroused considerable attention in England: and its publication synchronised with a number of letters and articles in the press in this country expressing a preference for the northern site. The latter voiced a natural attraction to the north site which the Committee themselves experienced on their first visit to Delhi, and enunciated some predilections which the Committee had at one time felt and later abandoned. These sentiments championed the northern site from the point of view of its more obvious advantages. It has its memorable association with heroic deeds and great names. It is the scene of the Durbars. It is the place where Their Imperial Majesties laid the Commemorative Stones. It is the place where such English population as Delhi has at present, now reside. It has some bungalows, gardens and trees. It is near some temporary amenities such as the polo grounds, the shops at the Kashmere Gate, and the Chandni Chowk, which the residents are in the habit of using. It shelters in reasonable comfort the existing population augmented by additions for the camp offices of the Government of India. Why should it not contain all the population which was to move here? These views were expressed with abundant force, honesty and enthusiasm, and undoubtedly have their roots in fact. Few of the writers however moved beyond the more obvious limits of the associations of sentiment and custom into the real problems of the situation. No thought was taken of the area which had to be provided, or of the total number of the population which must eventually reside on the site if this was to be the permanent capital and the seat of Government for seven months in the year. Full weight was not given to the undoubted ideal that the new capital was to carry on in British hands the tradition of Imperial Delhi and set a standard of beauty, comfort and health for India. The sanitary and engineering difficulties of the site and the question of cost found no place in

Revival of interest in the north site: its advantages.

these schemes. Above all to many this was the only site with which they had personal acquaintance, and the south site was dismissed from their horizon without a consideration of its merits as an unknown land.

Reason for reconsideration of the north site.

3. The public pronouncement of a distinguished engineer and the expression of a considerable volume of public feeling in favour of the north site demanded an enquiry as to whether any modifications of the original conditions would render it possible to use the north site. At the desire of His Excellency the Viceroy the Committee set themselves to consider whether any possible alteration of the data would make it feasible to place the New Capital on the north site.

The possibility of reducing the area required for the New City.

4. The original estimate of an area of 10 square miles was arrived at in the following manner. Lists were supplied by the Government of India of the number of officers, clerks and menials who would be located in the New Capital. Units of area were approved by the same body for the space for compounds. The decision of the Government was communicated as to the allowance to be made for Government House, the secretariats, residences for Ruling Chiefs, Indian nobility, gentry and plutocracy, commercial and educational requirements, administrative and municipal buildings. The total of these areas after allowance had been made for parks, expansion and roads came to 10 square miles. The problem now before the Committee was the reduction of the land required for the New City from 10 square miles to a figure which should not exceed the total area of good land which can be made available for building purposes on the northern site.

It was not of course possible for the Committee, in the short space of time available for the reconsideration of the question, to make a reference to the Government of India in regard to possible reduction of areas. All the departments were involved, and the previous figure had only been arrived at by the Government of India after lengthy consideration and discussion. It was not possible for the Committee to alter in any way the number of officers, registrars, clerks and peons, in regard to whom the Government of India had come to a definite decision that they would be posted at Delhi. It was considered unlikely by the Committee, that if Delhi was indeed to be the capital and seat of Government, any reductions, which might be made, would take the form of cutting down the number of officials and officers who would have their headquarters at Delhi. It was accordingly to the question of areas that the Committee turned their attention. The areas fixed by the Orders in Council, dated 21st June 1912, which were communicated to the Committee, were compounds varying in size from six acres for a Member of Council to 3 acres for an Under Secretary or junior officer. After consultation with various officers the Committee tentatively cut down the size of these compounds to a standard varying from 3 acres for the former to $2\frac{1}{2}$ acres for the latter. Another important change was made in the method of computation. Originally it was assumed that an official residence would be provided for every official. In working out a reduced scale of area however the Committee assumed that $\frac{1}{3}$ of the officials of the secretary class would live in hotels or flats and that $\frac{1}{2}$ of the deputy secretary and under secretary class would be similarly accommodated and would not require residences. Other reductions in other areas were also effected. Detailed lists were drawn out and compared by the Committee.

As a result of this comparison, while the total of the area of the original list after allowing 25 per cent. addition for roads came to 6,677 acres or rather more than 10 square miles, the total of the new list after allowing the necessary addition for roads came to 3,152 acres or almost 5 square miles. The former lay-out has an inherent provision for expansion as a large park space of 500 acres is provided and the large number of compounds admits of addition of other buildings as the town develops. The latter lay-out however has only 175 acres of park space and with the reduced number of compounds provides no inherent space for expansion. It was also necessary to assume in the latter case that certain items of the former list such as the residences of Indian nobility and gentry, the university, colleges, museum, oriental research institute, places of recreation such as theatres and concert rooms would have to be provided for in old Delhi outside the lay-out itself. The efforts of the Committee to secure a minimum lay-out point to the conclusion that an area of about 5 square miles is required and that this will provide no area for extension.

An attempt was made to exercise a countercheck over this figure by computing population in detail. The method pursued was to take each item in the former list and assume that a certain proportion of these units would be married and a certain proportion would have children, the number of servants to each officer or clerk, and the population of the native bazar, etc., was computed. The maximum figure reached was 57,000 and the minimum about 30,000. In the opinion of the Committee, though a maximum population must be assumed in this way for working out estimates of water-supply etc., owing to the speculative factor of the number to be added on for the families of officers, clerks, peons and servants, a population basis is an insecure one on which to calculate areas. There is a presumption that as far as Indians are concerned, as Simla offers little attraction to them to keep their families with them during their hill sojourn owing to lack of accommodation and uncongenial climate, the number of Indian families at Delhi will be considerable. In the opinion of the Committee if the speculative maximum of 57,000 souls were ever attained, a minimum area of 6 square miles would, in the interests of sanitation, be required for their accommodation.

For working purposes however, the Committee have decided to adhere to 5 square miles as the figure for a restricted lay-out.

5. Turning to the area available it is found that the total area of land lying to the east of the Grand Trunk Road, not at present developed, excluding the southern portion of the ridge, the parks, cemeteries, civil lines and open land outside the city walls amounts to four square miles: and that, if the area of the Civil Lines together with the *Bela* north of the railway bridge be added, a total area of five and a quarter square miles can be obtained for the site of the new city. A map of the district is attached to the report.

The area available for the new city on the north site.

The area subject to flood is shown on this plan; it lies to the west and north-west of the ridge. The low-lying land between the flooded level at 680' and the contour line of 685' is shown in yellow; the land actually flooded between 680' and 675' is shown in light blue, while the land which is flooded to a greater depth than 5 feet lying below 675' is shown by a darker shade of blue.

(a) Area subject to flood.

Adjoining the lands liable to flood and extending to their west lies the tract irrigated by the Western Jumna Canal. Much of this is heavily water-logged on account of the present unsatisfactory methods of irrigation by means of open earth channels and the existing lavish supply furnished by the canal. It will be noticed that even on the *bangar* or high land, many feet above the level of flood water, there is a permanent pond surrounded by marshes near the village of Wazirpur. Much of the soil is stiff clay and even if the water-logging was cured, it is not the sort of land, if other was available, on which it is advisable to build.

(b) Area irrigated by the Western Jumna Canal.

The area in between the Ridge and the river known as Civil Lines is intersected by 8 main ravines or *nullahs* which run in an irregular course from the foot of the Ridge in the direction of the river. The northern end of the Ridge itself is scarred with quarries from which metal for the construction of the Civil Lines roads Durbar and Temporary Delhi works have from time to time been taken. The soil at the base of the Ridge is poor and rock is near the surface. Considerable treatment would be required to render this strip of sub-colline land suitable for trees and gardens. Therefore the undeveloped land lying between the Ridge and the river as well as the northern end of the Ridge itself could only be utilized for detached buildings unless a considerable expenditure is incurred in the filling up and levelling of the *nullahs* and other rough portions of the site.

(c) The Civil Lines.

The *Bela* lies on the foreshore of the river in between Metcalfe House and the railway bridge. If a city is to be established on the north side at all, it is necessary, for purposes of sanitation and prevention of malaria, and in order to secure building land and aesthetic effect, to treat this area and adopt some form of river training. It is therefore intended to utilize it to the fullest advantage. In order to do this heavy expenditure must be incurred in raising it and in the formation of a river training wall and embankment along the whole frontage of the river from Wazirabad to the Railway Bridge, a distance

(d) The *Bela*.

of about 4 miles. The *Bela* must be raised to at least five feet above high flood level if it is to be fit for building purposes. It is to be remembered that the process of raising will take a number of years and therefore this area will not be available for building on till long after the rest of the city is complete.

Special points in connection with the north site.
(a) Cost and result of the purchase of Civil Lines.

6. The purchase of the Civil Lines, comprising an area of about 500 acres, has now been estimated to cost not less than £383,000; and, as its rearrangement to suit the new conditions would involve the destruction of a large number of buildings, which are at the present time in occupation, great inconvenience would necessarily be caused to the permanent residents in this portion of Delhi as well as to the members of the Government of India and their staffs. In fact it is probable that during a portion of the time while the new city was building, the present cold weather settlement of the Government of India known as temporary Delhi would have to be deserted, while the commercial community and the local administration would have to prosecute their vocations in the midst of intolerable noise and dust and a large accumulation of labour and materials. During this period communications would be most difficult, for although several miles of roads have in the past been constructed in the Civil Lines and large amounts of money expended, there has been no preconceived scheme of lay-out, and in any reconstruction of this area these roads could only be utilized to a limited extent as in many cases the gradients are steep and the directions irregular. Almost everywhere widths are insufficient and allow no provision for pavements of adequate size or efficient arrangements for drainage. It is to be feared that many of the trees and temporary amenities, which are the present attraction of the northern site, would have to disappear in the process of reconstruction. Those who wish to build on the north side should realize that they would be actually destroying many of the picturesque beauties which they most wish to preserve.

(b) Difficulties about the treatment of areas west of the Ridge: (i) Diversion of the Najafgarh drain.

If the area west of the Ridge is to be occupied by houses built closely together, as would be required in the case of a restricted lay-out, it would be found necessary to remove the Najafgarh drain entirely to a point south of the present city of Delhi, or to reconstruct it by a diversion of outfall to a point near the Kudsia garden creek. These are the only two courses which would work in advantageously with any lay-out on this site, and in the interests of health and appearance, and on account of the inconvenience of the numerous culverts requisite and the serious variations in its water level, it is quite impossible for the Committee to advise the retention of this drain in its present condition. The cost of the former scheme of diversion would be about £110,000 while the cost of the latter is estimated at £50,000.

(ii) Low-lying land.

This area is subject to flood from three different sources—the river, the Najafgarh drain and local rain. No treatment other than that of raising the area can, in the position prevailing, change it into satisfactory building land. The estimated cost at Rs. 12 per 1,000 c. ft. of raising these areas is as follows:—

Yellow, say 3 feet, £75,000 per square mile.

Light blue, 8 feet, £225,000 per square mile.

Dark blue, 11 feet, £300,000 per square mile.

It would also be necessary to treat the low-lying and flooded areas near the site so that they might be put into as good a position as possible from the malarial point of view; and it is felt that considerable expenditure would be incurred in meeting the reasonable requirements of the sanitary officers in this direction. The malarial history of the north site is bad while the record of the southern site is good. The Committee are of opinion that even after proper attention to sanitary matters the south site is likely to be generally better from the point of view of health than the north site. The great difficulty about the northern site is that not only is expensive treatment needed to enable the land to be used for building purposes, but the surroundings are also unhealthy, and considerable work entailing large expenditure would have to be undertaken on the environs of any new capital located in this area.

(iii) Sewage disposal.

The arrangements for the disposal of sewage would be difficult on this site, and a permanent sewage pumping station would be required in the neighbour-

hood of Wazirabad from which the sewage would be delivered to a sewage farm on land lying across the river, at a distance sufficiently great to prevent the possibility of justifiable complaint or contamination of the drinking water supply.

7. The want of room for expansion is a point which should receive very careful consideration especially as affecting a capital city intended to have a long life. Local social or economic conditions, many of which are of a purely temporary character, should not be allowed to have undue weight attached to them in competition with the needs of the future. Foresight is the essence of successful town planning. The Committee feel that in coming to a conclusion as to the suitability of any of the proposed sites they should pay more attention to the requirements of the future than to the views of those who are interested for special reasons in a particular locality. There is often a tendency to give undue weight to troubles which are only likely to be of short duration; for example, it is quite true that for a time at least some inconvenience may be caused owing to the change in position of the present shops and shopping quarters, when the Government of India move to the south site; but too much importance should not be attached to this point, as in the event of any well considered scheme of lay-out being adopted, the shops and hotels, as experience has shown elsewhere, will follow the traffic and develop in the neighbourhood of the new main railway station.

General points in connection with the new city :
(a) The question of room for expansion more vital than ephemeral amenities.

The cost of the north site and its preparation, if charged to the tenants or occupiers on the whole area in the form of rent, would be a serious handicap. The effect of choosing it might well be that the expansion, which may naturally be expected in a capital city, would not take place, or at any rate be diverted in other directions.

(b) The initial cost of the ground.

The Committee were informed that it was the intention of Government to locate a new cantonment in the vicinity of the new capital. In such cases a healthy and sanitary situation is vital, because it must be remembered that the cantonment has to be lived in all the year round. The area to be provided is large. Where a large expanse of land with a good fall and healthy condition of subsoil water does not exist, the cost of raising levels of land or alternatively the cost of providing artificial drainage and possibly pumping plant to remove water after heavy rain is a serious matter. The fact, therefore, that no large tracts with favourable natural conditions of surface drainage can be provided in the vicinity of the north site is a feature of much importance. The Military Authorities have twice failed to find any suitable site in the neighbourhood, and the most that could be done under the circumstances was to reserve a square half mile where a detachment from the cantonment on the south could be located. This area is marked "Military" on the Map.

(c) The provision for cantonments.

No site in India can be considered suitable unless it provides room for outdoor sports and recreations under healthy surroundings; and the general character of the land lying outside the proposed building area will not be satisfactory, even after it has been dealt with by drainage and treatment. It will not be possible to make such spaces available for use throughout a considerable portion of the year as the land is a stiff retentive cold clay and the situation such that it cannot be guaranteed against malaria in bad seasons.

(d) The provision of land for recreation.

It is felt that it would be a grave mistake if a point of view was adopted that the Civil Lines with some additional buildings could be the capital of India and the seat of Government. It would appear to be a complete desertion of the ideal of the conception and a drifting away from all breadth of treatment and largeness of view. It is considered that the main features and buildings of the new city should at any rate be as interesting, after centuries have passed, as the older buildings in the neighbourhood are at the present day.

(e) The narrowing of ideals.

8. The plans, which have been prepared, show that the area of good ground available is, however, sufficient to meet the immediate present requirements as reduced, and that a city, most of which will be closely built, can be laid out on the northern site. There are drawbacks, however, to a lay-out even of this size. Calcutta conditions in the climate of Delhi for a seven months' residence are an impossibility.

Planning on the north site.

Scenic aspect from north Ridge.

It is quite true that the views from the historic portion of the Ridge are very extensive and beautiful especially in the evening with the foliage in its present condition; but it should be borne in mind that when the surrounding area is closely built upon, the conditions will be different; many of the trees, which at present exist in the large compounds in the Civil Lines, will necessarily have disappeared, and most of the fine views will be spoilt by the roofs of houses and buildings, which in some cases will be level with the eye when driving or walking along the Ridge. The view to the west from that portion of the Ridge, where the Mutiny Memorial stands, is much spoilt by the manufacturing suburb of Sabzi Mandi with its tall smoky chimneys. This suburb is an unpleasant neighbour for the north site, severely handicapping any successful plan. The cost of its acquisition or radical modification however is so great that the Committee unfortunately cannot see their way to make a recommendation in regard to its removal. As one of the chief commercial assets of Delhi it would be out of the question to limit its expansion in the future.

The Committee were at first very favourably impressed with the purely architectural possibilities of portions of the northern site and deserted its power for scenic and architectural beauty with regret. If the city to be designed were to occupy only 3 square miles, and lavish expenditure could be faced, it would be possible from an architectural point of view to obtain fine results.

Comparison of cost of a city on the North with a city on South site.

9. In making calculation for comparison it has been necessary to assume that a lay-out on the south site will also only occupy 5 square miles. The actual charges falling on land will be as follows on the two sites:—

	North.	South.
Cost of land	£420,000	£100,000
Special treatment of north site—		
(a) Bela and promenade	450,000	
(b) Levelling	95,000	
(c) Raising lowland	55,000	
Special treatment of south site		53,000
Total	£1,020,000	£153,000

The extra cost falling on land is £867,000 on the north site.

The excess cost of other operations on the two sites is as follows:—

North.		South.
Equal	{ Sewage and storm water Water supply Irrigation Roads }	Equal.
£50,000	Najafgarh Jhil Drain	
£50,000	Canal (Western Jumna)	
Equal	River training	£50,000
	Railways	Equal.
	Afforestation	£45,000
Total £100,000		£95,000

The total extra cost of the adoption of the north site would thus be £872,000.

A brief discussion of Sir Bradford Leslie's scheme.

10. Sir Bradford Leslie's object in preparing his scheme appears to have been to provide the province of Delhi with improved public health, electric power, additional land for building and an improved river frontage; he proposed to accomplish this as follows:—

- (i) a large lake to be constructed by building an over fall weir at Feroz Shah Kotla, the surface to be four feet above flood mark, *i.e.*, at R. L. 676.
- (ii) the large volume of water thus stored to be used for electric power and to replace the losses by evaporation and absorption from the lake itself.
- (iii) the electric power to be used for pumping drainage from the Durbar area, also for dredging to raise land for building along the river front.

From the plan that accompanies his paper it is evident that the author had very little accurate information in regard to the site or in regard to the conditions of flow in the Jumna. The conditions of the site are such that large areas must be submerged or elaborate embankments and drainage works constructed as a remedy. The variations of the latter preclude the possibility of extracting useful power, as the fall in the monsoon months and the flow in the remaining part of the year is small and uncertain. Furthermore the capacity of the lake would soon be reduced by silting to the size needed to discharge the normal monsoon volume. In any case the stored water must replace evaporation losses as well as supplement the supply required by irrigation and power, two functions that are not likely to help each other out when the weather varies from the normal. The power would be costly to instal, uncertain in quantity and could be of no commercial value, being subordinated to the duties of pumping and dredging necessitated by the design of the lake.

The proposal in the form advanced is not practical; but with levels suited to the locality and without the adjuncts of hydro-electric power, a river training scheme can be devised that would improve the health of the city, add to its appearance and incidentally help to redeem land that would eventually be valuable.

A longer discussion of the more technical points in the scheme is printed as an appendix to this report.

11. The advantages and disadvantages of the north and south sites may now be finally considered. On the north site there are the associations of 1857, of the Durbars and of the Commemorative Stones laid by Their Imperial Majesties. Proximity to the river and the Ridge give certain scenic advantages. In the winter months the site is generally upwind of the present city. It is also up stream. There are the temporary amenities of proximity to a shopping area, a railway station and existing recreation grounds. It is apparently nearer to the present city of Delhi. It is at present used as a residence by an existing permanent population and by the camp offices of the Government of India in the cold weather; its adaptation to be the permanent seat of the Government of India is therefore not beyond the limits of possibility. There are some roads, bungalows and trees on the area already. The Committee freely admit the great architectural possibilities in the site provided the area required can be restricted to three square miles and there is no lack of money to be spent. Conclusions in regard to the north site.

The disadvantages of the site appear to the Committee to be as follows:—

In the first place, in order to fit the city on to this area at all, the areas allotted by the Government of India for each item in the city have to be cut down, and certain items have to be excluded entirely. This is beginning town planning at the wrong end, when equally suitable sites are available elsewhere. The site should be chosen to fit the requirements, and not the requirements modified to suit the site. While the Committee do not deny that some cutting down of the areas originally provided is possible and probably desirable, the question of reduction of areas for residence to a minimum is one in which there is room for considerable difference of opinion. Even if it is assumed that those at present interested in the site are desirous of living in small compounds, it is equally conceivable that those who follow them may not be of the same opinion, particularly as it may well happen that at some future time a greater proportion of the year will be spent at Delhi by the Government of India than is at present contemplated. The idea of limiting the provision to be made in the new city and of providing no room for expansion augurs a lack of faith in the fortunes of the new capital as the permanent seat of the Government of India. It would be building on an insufficient framework based on small ideas rather than large views. Such a policy could hardly produce a city which would give a capital, evolved under the guidance of British rule, as a pattern and inspiration to the East. Yet apart from the ideals conceived for her, everything promises well for new Delhi. To deal with the question of associations. By adopting the south site, the heritages of the memories of 1857 and the Durbars are not lost to us. The new city on that site however goes back further and gathers the strands of many centuries and empires into the new Imperial whole. The scenic effects

of the Ridge and River can be secured on the south side also. The Ridge can be afforested there and a wild park made where the view will not be spoilt by the smoky vistas of Sabzi Mandi. A water effect can be afforded there at less cost and without sanitary drawbacks. It is to be remembered that all the fine monuments of the Delhis of the past are to the south. During the period of the residence of the Government of India the site to the south is sheltered from the cold weather winds and far enough from the Ridge in the warmer months to escape the radiation of heat. On the north, half the site is exposed to the north and north-west winds of the winter and the rest is too near the Ridge for comfort in the heats of the autumn and spring. The remarks about sewage disposal on the north site show that the upstream position of the city is a positive disadvantage. The temporary amenities of the northern site would mostly disappear in the process of reconstruction. During this period the permanent residents would be subjected to great discomfort and inconvenience while the Government of India would probably have to stay away altogether. Better trees and better gardens can be made on the southern site. The work of construction on the southern site can proceed without disturbance to the present population of Civil Lines or the temporary residents from the Government of India. That the present residents of the northern area would with few additions be the eventual population of the new capital is a fallacy. Only about $\frac{1}{4}$ th of the officials and about $\frac{1}{10}$ th of the clerks and peons of the Government of India are in Delhi at present, and these have only the reduced establishments rendered necessary by the exigencies of insufficient accommodation and camp life. It is hard to visualise a new city on the southern site and compare it with existing conditions on the north; but a study of the various lay-outs which the Committee have attempted, show that Government House on the southern site may actually be nearer the Juma Masjid, which may be taken as the centre of Delhi, than when located on the north site. The distance of the nearest edge of new Delhi to old Delhi on either site will be the same. Hotels, shops, and recreation grounds and other amenities and conveniences will spring up where the people go and where fashion or necessity dictate on either site. The soil is poor on the northern site as compared with the southern. The southern site is already healthy and has healthy surroundings. The northern site even after expenditure on sanitary requirements will never be satisfactory. If the northern site is to be made healthy, this involves going outside the site itself and making the neighbourhood healthy also. The building land to the south is generally good. On the north to be used at all it has in places to be raised at considerable cost. There is no really suitable healthy site for a cantonment in proximity to a city on the northern site. The exigencies of fitting in the requirements to the limited area of the northern site endanger the success of a lay-out as a whole and tend to make for cramping and bad arrangement. The result of placing a city on the northern site appears to the Committee to be the creation of a bad example in place of a good one.

It is unfair to tie the hands of the future and reject the dictates of foresight. The governing principle of the town-planning movement is foresight. Though the desire to improve and beautify has been grafted on to it, much to its advantage, the movement originated not in aesthetics but in necessities, borne in on town dwellers of all countries by hard experience of difficulty of communications, dear land and out of date sanitary conditions, involving inconvenience, congestion, bad health and vast expenditure. Above all they had learned the need for space, space at the centre to allow of the creation of fine buildings and improved amenities, space on the outskirts to accommodate an increasing population. For, in the twentieth century few cities are decaying or standing still. The majority are expanding by leaps and bounds.

It is inconceivable that Delhi will not grow. She is the most central spot in the Railway system of India; she possesses historic and artistic interest, and she is once more India's governmental Capital. Necessity, convenience, and fashion will all bring people to her.

And, if she must expand, let this be remembered. It is a question of comparison.

If the city is placed on the south side expansion will take place over land which is cheaper, better, and more healthy the further she grows.

On the north, once she overlaps a limited area, the land becomes more costly to buy or to treat, worse in soil and less healthy.

The Committee were brought to India to advise on town planning. They would be false to their trust if they gave any other advice than this.

Even now, with the requirements of the city cut down to the lowest point, they must re-affirm the views which they expressed last June. They believe that the northern site is too small and too cramped, and that a worthy city cannot be safely fitted upon it at all, far less provided with ground over which to expand, without including some land which will be very costly to buy and much land which will be very costly to make healthy, even if so sour and poor a soil can ever be made really healthy.

They hold that when there is a better, cheaper and healthier site conveniently at hand it is out of the question for them to advise the Government of India to select this northern area for the site of the Imperial Capital.

GEORGE S. C. SWINTON,

Chairman.

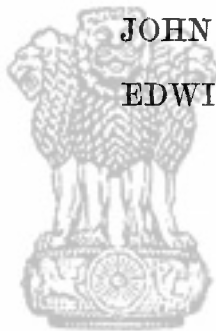
JOHN A. BRODIE,

EDWIN L. LUTYENS,

} *Members.*

EXPERTS' CAMP, DELHI,

Dated 11th March 1913.



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APPENDIX.

Note on Sir Bradford Leslie's scheme as propounded in his paper entitled "Delhi the Metropolis of India" read before the Royal Society of Arts.

Objects and general arrangements of the scheme.—Sir Bradford Leslie's object in proposing his scheme is to provide Delhi with improved public health, with electric power, additional land for building and an improved river frontage, and he proposes to accomplish the object by the construction of an overfall weir across the Jumna with roller shutters designed to hold up surplus flood water to a maximum height of 4 feet above the high flood mark opposite Firozshah Kotla. This level would be R. L. 676, and water at this height would submerge the whole of the Bela in front of Delhi to a depth of 6 to 10 feet and also a large portion of the Barari plain to a depth up to 4 feet. Sir Bradford Leslie in his paper does not explicitly mention the necessity for any arrangement to exclude water from the Barari plain but perhaps this was because he had no knowledge of the land levels at hand, and he clearly recognises the desirability on the grounds of health of keeping the Barari plain dry, as he formulates a scheme for draining the Durbar area by pumps, actuated by water-driven electrical machinery, during periods of large flow in the river. Unless confined within restricted limits the lake would flood a very large area on the left or east bank of the river both above and below the bridge, and this undesirable result Sir Bradford proposed to obviate by the creation of a reclamation embankment six or more miles in length and of sufficient width to allow of roads and building sites; such reclamation to be carried out by dredging from the river bed.

Included in his scheme is a proposal to reclaim about half a square mile of land on the right bank of the river from Chandrawal to Selimgarh Fort, also by dredging from the river-bed. By these means the object of the scheme is to be attained, in so far as it causes the submersion of the low-lying Khadir lands, which form, in his opinion, at present a malaria nidus; with questions of health this note has nothing to do, confining itself merely to the engineering problems connected with the scheme.

2. *The advantages to be got by storage.*—Sir Bradford claims that, by the storage of large quantities of water by means of a weir, the following advantages will ensue:—

- (a) The possibility of generating electrical energy by means of water-driven electrical machines.
- (b) Compensation for loss by evaporation and percolation.
- (c) A valuable storage for supplementing the supply of the Agra Canal off-taking from the river at Okhla in times of need.

3. *Hydro-electrical energy.*—First, as to the generation of electrical energy, it is evident from the plan submitted with his paper, that Sir Bradford Leslie had very little accurate information with regard to the site at the time of writing, and this no doubt led him into error with regard to the possibility of obtaining electric power from water storage. The conditions of flow in the river Jumna, however, precludes the possibility of extracting useful power continuously throughout the year, as during the rainy season, there is a large flow of water without the possibility of any appreciable fall, whilst in the dry season, as most of the water (in fact, for some months the whole of the water) is diverted into the canals at Tajawala, the flow in the river at Delhi falls very low, and indeed it would not be possible to count on a greater flow than 100 cusecs, and even this figure is a risky one to take as a certainty. The lake proposed by Sir Bradford Leslie would be $16\frac{1}{2}$ miles long and of an average depth of about 10 feet. If we assume it to be on the average of a width of no more than 900 yards, the quantity of water stored is equivalent to 27,225 cusec-days.

Sir Bradford Leslie talks of the whole area of the Khadir being submerged by the proposed lake. This would involve an enormous area owing to

the great width of the Khadir, and artificial embankments to confine the lake to reasonable dimensions are essential, as otherwise nothing but continuous excavating would prevent the formation of mud flats, when the lake level was lowered and in addition the losses from evaporation and percolation would be too great to be compensated for by the flow in the river.

If, to supplement the supply for the generation of electrical energy, the lake is lowered by six feet, by drawing off the water (which is what is understood to be Sir Bradford Leslie's intention) the amount released would be 13,500 cusec-days, and, as it would not be safe to assume that this could be released in a shorter time than three months (*i.e.*, that the flow in the river might easily be in the neighbourhood of 100 cusecs for three months), the available flow from the storage to supplement the natural flow in the river would only be 135 cusecs. Under the most favourable conditions, and taking into consideration the maximum fall that can be obtained, the flow of water for the generation of electrical energy that could be relied on for commercial purposes would be only 235 cusecs, and the horse power obtainable only some 300. When the flow in the river increases, the horse power would of course be greater, but, for commercial purposes, the supply of electrical energy would have to be guaranteed, or intending consumers would fight shy of the scheme, and so the minimum supply is the basis for tackling the scheme on commercial lines.

When really large floods come down the river, the available fall would decrease so largely as to render the extraction of power from the water almost, if not quite, impracticable.

The effect on the régime of the river, and the adjoining country, of impounding the water has to be considered, as also the means required to preserve the régime. In the first place the Barari plain and much of the land behind the reclamation embankment on the east bank of the river would become a swamp owing to the height to which the lake is proposed to be pounded up, and consequently powerful pumping plant would have to be installed to remedy this defect in the case of the Barari plain and elaborate arrangements for draining the land on the east of the river into the Hindan river valley would be necessary in addition to the general filling up of this swamp by warping or mechanical means.

In the second place, even assuming that the weir is fitted with sluice gates, an absolute essential unless dangerous silting up of the whole bed of the river is to occur, the effect of the lake will be to decrease very greatly the velocity of flow of water entering the lake, and consequently silting up would occur. This phenomenon and the lines that it follows are well known to engineers versed in river training, and need not be enlarged on further than to state that, with the exception of the cunette, which is sufficient to carry the normal monsoon river, the rest of the bed of the lake would gradually silt up. Recent observations show that this cunette would be some 400 yards wide with a depth of some 12 feet. In the initial dredging of the river, this cunette would have to be created artificially to a more or less correct section (the river eventually correcting inequalities) and it is more than possible that dredging operations both to keep open this channel and to clear excessive silt from the bed of the rest of the lake would be not a temporary but a permanent arrangement. In this dredging of the river bed, and in the pumping out of the Barari plain, it is probable that the whole of the meagre 300 H.-P. created by the storage would be expended. In other words, the whole energy provided by storage would be expended in remedying evils, created by the storage; a fact which appears to put the possibility of the generation of electrical energy by the storage of water out of court. It appears indeed to involve the expenditure of capital and labour in the creation of a perpetual deadlock.

4. *Compensation for losses by evaporation and absorption.*—Turning now to the question of compensation for loss by evaporation and percolation, experience has shown that the evaporation losses will not be less than an average of $\frac{1}{4}$ th of an inch per diem, and in the dry hot season (when incidentally the release of storage water, whether for the possible generation of electrical energy or for supplementing the supply of the Agra Canal, would be most imperative) the loss will be about $\frac{3}{8}$ th of an inch. But taking the figure of $\frac{1}{4}$ th of an inch the loss by evaporation over the lake proposed by Sir Bradford Leslie would be,

when the lake was quite full, 4,900,000 cubic feet per diem or 57 cusecs, and when the lake was lowered by draining off 6 feet of water, 3,267,000 cubic feet per diem or 38 cusecs.

Sir Bradford claims that, if the whole bed of the proposed lake lies over an impermeable layer of clay, the percolation losses will be practically *nil*. Certainly such a layer exists both at Chandrawal and at the railway bridge, and, if Sir Bradford's assumption is accepted that it probably extends over the whole area of the lake, the loss by percolation vertically downwards would undoubtedly be practically *nil*. But, at the same time, it is known that water, in the dry cycle of years, flows from the river into the subsoil and therefore there is a loss by percolation laterally. By raising the level of the water permanently this loss would undoubtedly be increased. What this loss would be is very difficult to say, but that it would be considerable there is no manner of doubt. These losses by evaporation and percolation would possibly be met by the impounding of the extra four feet above high flood level, but they would be a direct loss to the quantity of water, that could be released from storage for the purposes, which Sir Bradford Leslie contemplates.

5. *The value of the storage to the Agra Canal.*—Thirdly the possibilities of the storage as an efficient standby for supplementing the Agra Canal supply in times of scarcity may be discussed. It has already been shown that the whole lake provides a storage of 27,225 cusec-days. This figure has to be reduced by the evaporation and percolation losses, taken as four feet in depth of the lake amounting to 9,735 cusec-days, leaving a balance of 17,490 cusec-days.

The storage would therefore permit of some 175 cusecs being supplied to the Agra Canal continuously for three months assuming the lake to be completely emptied, or a larger flow could be given at intermittent periods, should that be more desirable, as, under the circumstances of irrigation in this part of India, would be more likely.

It should also be noted that water percolating laterally to the west would owing to the presence of rock westwards from Okhla, re-enter the river bed above the Okhla weir, while that percolating to the east would once more get back into the river bed partly above the Okhla weir, but, in all probability, mostly below the weir by way of the Hindan river. The percolation losses are not therefore dead losses though the evaporation ones are, but they are losses affecting the possibilities of the local lake as a storage lake.

It would seem therefore that the effect of pounding up the river would be to form a valuable storage for the Agra Canal as claimed by Sir Bradford Leslie. This claim appears to be substantiated.

6. *The water effect can be more conveniently got by designing to more appropriate levels.*—Having thus shown that the generation of electrical energy by the creation of a storage is not a practical scheme, it only remains to add that the advantages obtained by impounding the river, namely, the submersion of low-lying lands, at present a malaria nidus, and the forming of a supplementary supply for the Agra Canal, not to mention a water effect for the new Capital, can apparently be brought about by the construction of a weir with sluices across the river. The level of the water would have to be determined by consideration of the effects on lands adjoining the river and on the subsoil flow generally, and would, in all probability, be between R. L. 672 and R. L. 666 at the railway bridge, the former being a maximum, owing to the levels of the Barari plain. Where the low-lying lands are not sufficiently or possibly not at all submerged by a lake, pounded to some such level, it would be necessary to raise such low-lying lands above lake level to prevent the existing evils of a malaria nidus continuing in the future.

7. *The cost of the reclamation of the civil Bela and building site on the east bank.*—One of the points raised by Sir Bradford Leslie in propounding his scheme is the necessity of reclaiming 320 acres of land on the river side from Chandrawal to Selingarh Fort. This it is proposed to carry out by dredging, and the creation of building sites and the formation of a lake side boulevard are formulated. This work is treated by Sir Bradford Leslie as being essential. It will be instructive therefore to consider what work this portion of the scheme would involve.

In the first place the area of 320 acres will have to be filled up to an average depth of some 12 feet, and this necessitates the shifting of six millions of cubic yards of material. Taking Sir Bradford Leslie's estimate of one shilling per cubic yard, the cost of this would be £300,000.

On the east bank, too, reclamation is necessary, and assuming that raising to a height of eight feet above existing ground level is adjudged sufficient, and that the width of reclaimed land is only 100 yards, then the amount of material to be shifted to make this reclamation some six miles in length would be some $2\frac{3}{4}$ millions of cubic yards at a cost of £167,000.

Sir Bradford Leslie, however, also contemplates the creation of a settlement for Indian subordinates on the east side of the river. The area required is one square mile and as such a settlement would have to be comparatively near the Government offices, only some three miles of the reclamation embankment could be used for that purpose, or 100 acres, so that some 500 acres more of artificially raised land would be required. This means the shifting of a further $6\frac{1}{2}$ millions of cubic yards at a cost of £325,000. In addition the reclamation embankment must be revetted, and even if this is done as cheaply as possible, taking the risk of possible scouring which may be considered permissible in view of the fact that the buildings would not be very valuable ones, the cost would not be less than £25,000.

But, in addition to this, on the west bank reclamation, a retaining wall on the lake side would be an essential, as otherwise scouring and undercutting by the river in high flood would endanger the stability of the reclaimed land and render it unfit for building sites or for the creation of a fine boulevard. Sir Bradford Leslie recognises the necessity for a stone-faced embankment. Such a retaining wall would have to be constructed on wells, founded on the clay substratum; unless this work were very soundly built the danger from scouring to the valuable buildings would be too great to be contemplated. The cost of such a retaining wall, with its superstructure forming an ornamental balustrade along the boulevard, would amount to some £450,000.

In fine, the absolutely necessary work, excluding all question of further desirable reclamation, would cost not less a sum than £942,000. This does not include the cost of the weir and training works below the bridge. While, if further reclamation for the purposes of a settlement on the east bank is made, the additional cost would be £325,000.

The cost of the reclamation of the 320 acres on the west bank would be £750,000. This is equivalent to an outlay of over Rs. 7-4-0 per square yard or nearly ten shillings, and this is the cost over the whole area, including roads, open spaces, etc., so that probably the cost for actual building sites would be nearer Rs. 30 or £2 per square yard.

As Sir Bradford Leslie states that the weir must be first constructed to give sufficient depth for the dredgers to be floated, it is clear that this reclamation cannot proceed *pari passu* with the construction of the buildings of the new city, but must await the completion of the weir. In other words the weir is an essential feature of Sir Bradford Leslie's scheme on all grounds and is the first item of construction to be proceeded with.

8. *A bridge will be required to supplement the motor launches.*—Communication with the suburb on the east bank is to be by covered motor launches plying between piers; this assumes that it will never be necessary to lower the lake below a navigable depth, a contingency that must frequently occur if the storage is to be of any value to the Agra Canal, and therefore communication by a suitable bridge should be added to the cost of the development of a building area on the east bank.

GEORGE S. C. SWINTON,

Chairman.

JOHN A. BRODIE,

EDWIN L. LUTYENS,

} *Members.*