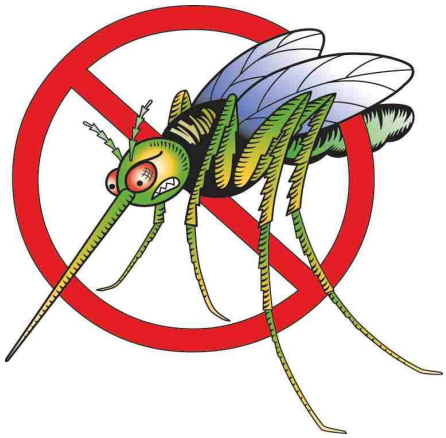
EXECUTIVE SUMMARY

IMMC

INTEGRATED MOSQUITO AND MALARIA CONTROL

LIBERIA



A comprehensive integrated mosquito and malaria control program to reduce the incidence of malaria, and other insect spread disease in the human population

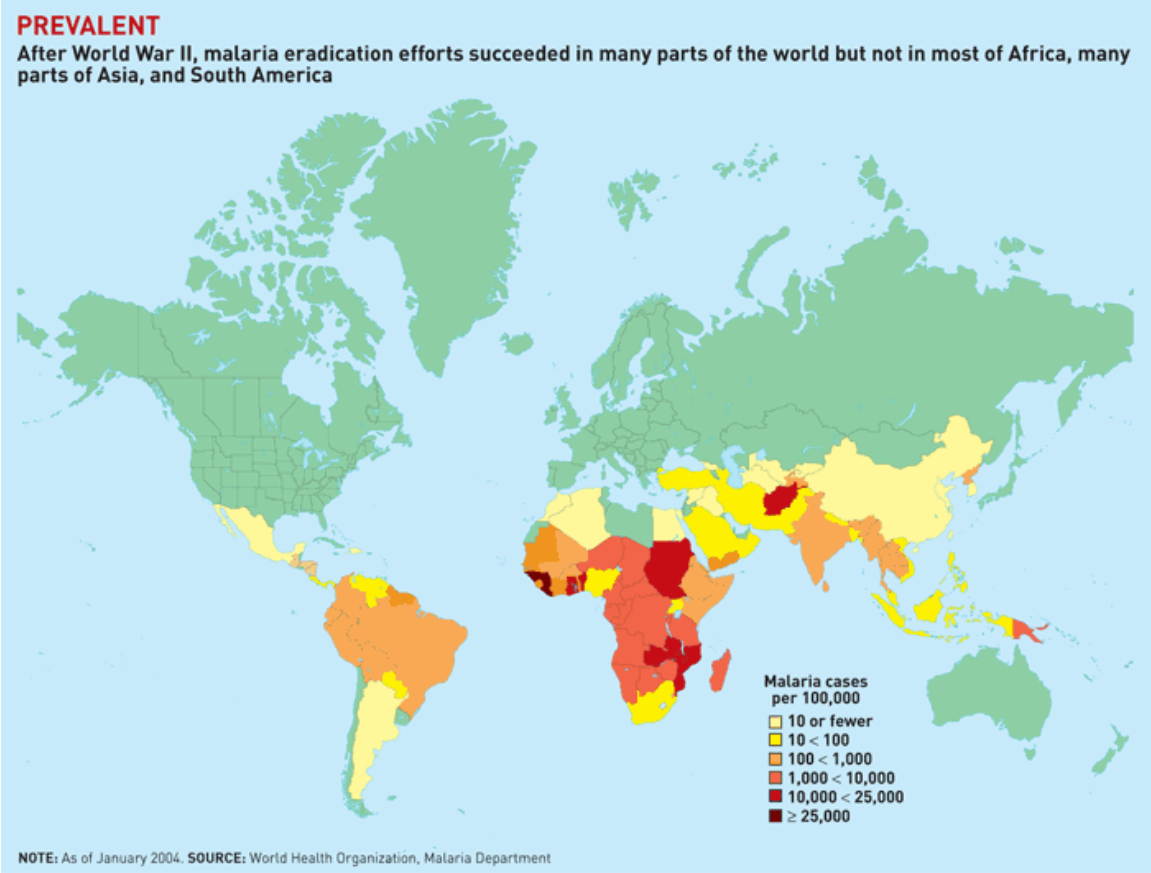
March 2006

DRAFT – FOR DISCUSSION ONLY

MALARIA SHOULD BE A MAJOR HEALTH PRIORITY

An estimated 500 million cases of acute malaria occur worldwide each year, predominantly in Sub-Saharan Africa where there are about 450 million cases annually. There are as many as 1 million deaths a year, primarily among infants and young children. Every 3 minutes a child dies of malaria, or about 3,000 children a day die of malaria.

The WHO map reproduced below shows the incidence of malaria as of 2004 around the world.



All rich countries have become malaria free and are able to maintain this status. It is possible to control mosquitoes and malaria but only with a relevant comprehensive integrated program. Poor countries in Africa have not implemented such control programs and the malaria epidemic continues.

Malaria is a parasitic disease. The malaria parasite lives in the blood and attacks the internal organs, including the brain. The parasite moves from host to host through mosquitoes, as they feed on human blood. There are three approaches to reducing malaria: (1) reducing the mosquito population; (2) reducing human contact with the mosquito vector; and, (2) reducing the malaria parasite. The best sustainable results are achieved when all are used.

ECONOMICS OF MALARIA

Malaria is a killer disease, especially for children. In a US or European setting, medical malpractice that results in the death of a child has a multi-million dollar value, yet some 3,000 children die every day from malaria in developing countries, mainly Africa, and it is as if this has no value. Up to now global leadership has not seen fit to fund and implement effective control programs in Africa and malaria remains an endemic disease that has devastating economic consequences.

Malaria is a debilitating disease for adults. Malaria induced fever makes people lethargic and very unproductive. As much as 10% of work time is lost because of malaria. This is observed in formal jobs as well as in the informal sector and self-employed work, such as agriculture. A loss of 10% of the economic product in a poor economy is very serious, but difficult to quantify. In a society where $400 is the per capita product, it can be argued that it is a mere $40 a year, but this may not be good metric. A 10% loss of product in a rich country where a person generates product of $20,000 a year, the computation would be $2,000. The argument must also be made that $40 in a poor economy has far more socio-economic value than $2,000 in a rich economy.

The per-capita value and economic potential of a society that has endemic malaria is many hundreds of dollars lower than a society that is malaria free. The per-capita value increment is somewhere between $40 per capita and $2,000 per capita, but precisely where is unclear. A place like Florida in the USA would not be a booming real estate market with a growing population if it still had malaria.

The cost of implementing a comprehensive integrated mosquito and malaria control progam depends a lot on the management and operation of the program. The cost of killing mosquitoes can be quite modest, say a direct cost of $1.50 to $2.00 per acre, but because mosquito populations rapidly reestablish themselves, this cost is ongoing, so the cost is ongoing and for five years the per acre cost becomes something like $90 to $120. This assumes low cost aerial Ultra Low Volume (ULV) spraying rather than more costly ground applications. The cost of medication to elminate the malaria parasite from an individual person is perhaps $5.00 per person, though this could be significantly lower if natural parasite reduction is acceptable.

In an urban area of 50,000 acres with a population of 1 million seriously affected by mosquitoes and malaria a minimum program cost is going to be about $6 million direct cost to address the mosquito problem and about $5 million direct cost to address the parasite problem. In addition there needs to be the data collection and analysis work that is essential to making the program effective and directing operations. A program of this size needs a technical and management team, together with physical support facilities and equipment that adds perhaps 40% to the direct costs to make a total program cost of a little more than $15 million or $15.00 per capita, which over five years is $3.00 per capita per year.

If it is assumed that the per capita value increase is just $40.00 ... mosquito malaria control is clearly a value creating initiative ... and if a higher value such as $200.00 is attributed to the per capital value increase, then the initiative is even more desirable and justifed as a priority.

PROGRAM STRATEGY

The Program is driven by the the interaction of science, technology, cost and value. Entomology and medical science define the limits of what is possible, and cost and value determine how science and technology can be used to best effect.

The Program is comprehensive and tightly integrated so that performance facts can be used almost in real time to determine what is the best technical approach to the control activities. This is to be achieved by continuous data collection in the Program area and immediate analysis of data to provide feedback to operational decisions.

The Program aims to control mosquitoes so that the malaria vector is reduced, and simultaneously start to reduce the parasite in the human host. Without intervention to control the mosquito population, it grows rapidly, and serves as a very efficient vector for moving the parasite from person to person. Without intervention in parasite control the mosquito picks up infected blood and carries it to the next person. Both mosquito and parasite need to be the subject of effective intervention. Durable success is achieved when the parasite has been reduced throughout the human population, and there is little transmission whether or not the mosquitoes are biting or not. Ongoing mosquito control is then a matter of comfort rather than being a health critical initiative.

All techniques for control of mosquitoes are included in the Program including aerial ultra low volume (ULV) spraying, mechanized ground fogging, hand spraying in hard to reach areas, and interior residual spraying (IRS). The exact mix of interventions will depend on entomological findings and cost analysis. The lowest cost intervention appears to be ULV aerial spraying of adulticides. IRS and larvaciding in some areas may also be cost effective, especially if the use of DDT is permitted. The goal of the Program, however, is not reduction in the mosquito population but reduction in the transmission of malaria and the incidence of malaria in the human population.

The following is a typical aircraft used for ULV spraying:

The selection of interventions is based on data about the mosqitoes and the way in which they have responded to actions to date. It is also based on analysis of the medical information to help focus on interventions that achieve best results at lowest costs. A set of simulation models will be developed to help determine the best course of action to optimise performance.

The following shows ground fogging and the use of hand carried spray equipment:

Mosquito population reduction is a step in reducing transmission, and a step in the control of reinfection within the human population. Reinfection drops as a function of both mosquito population and the proportion of human hosts infected with the malaria parasite. Accordingly at the same time that the mosquito population is being controlled, there is also a component to reduce infection in the population at large.

A rudimentary interactive model of the various technical interventions and the cost and the results suggests that the Program will be able to achieve durable results for around $15.00 per capita over an initial 5 year period, and perhaps less than $1.00 per capita per year in the long term future.

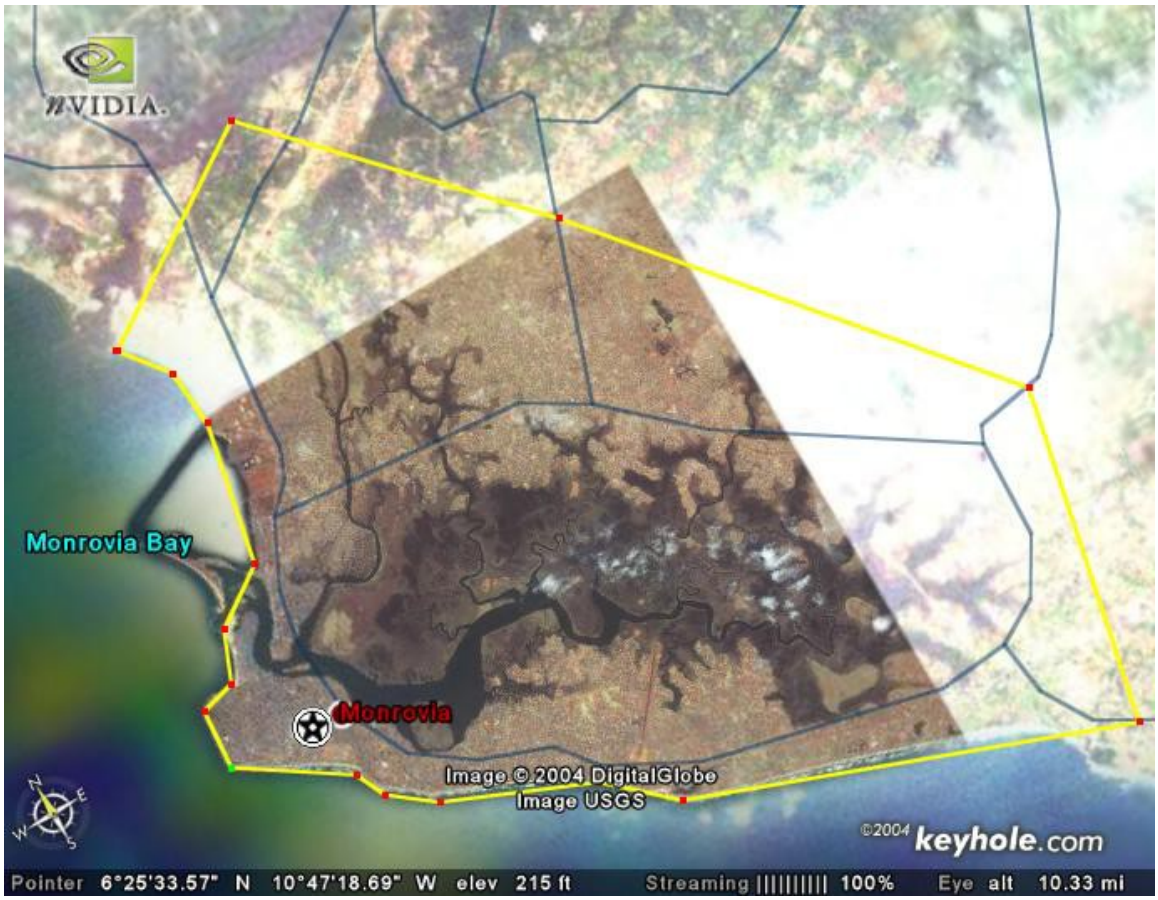
The long term control of mosquitoes requires ongoing measurement of the population and assessment of best ways to maintain control of the population. The Program will use the idea of Mosquito Abatement Districts to provide an effective link between the community and the Program activities. This included both data collection and being the focus for public information campaigns.

THE MONROVIA MOSQUITO / MALARIA CONTROL PROGRAM

This Program has been formulated for Monrovia, Liberia, a location suffering from endemic malaria.

The Program Location – Monrovia Liberia

The population of Monrovia was around 500,000 prior to the civil war, and since the war insecurity and influx of displaced persons has probably expanded it to more than 1 million. Monrovia covers an area of around 50,000 acres. It is unusual because of some 15,000 acres of marshland, a perfect breeding ground for mosquitoes, located in the center or the built up area. On the map below, the area within the yellow lines is about 50,000 acres. The dark brown represents the marshy area of about 15,000 acres.



Suggestions have been made in the past that the marsh should be drained, but that would be costly and technically difficult because it is both tidal and river fed. It also poses major environmental questions related to wetlands and aquatic resources.

The majority of Monrovia's population is very poor and live in quarters that are very crowded and disorganized. Perhaps half the population are now living in

squatter conditions, and road access is very limited. The picture (below) of the Bushrop Island neighborhood of Monrovia is an indication of the difficulty ground operations will have to face. The yellow line represents ¼ mile. A strategy that uses ULV aerial spraying is very much suited to these areas.

The picture (below) of the Sinkor neighborhood shows a different set of physical conditions, and different issues for effective ground operations. Note in both cases how few of the buildings are road accessible and within range of effective mechanized ground fogging. Again, this area is suited to ULV aerial spraying.

Management and organization

The Program will be managed by an independent private not for profit organization committed to: (1) performance excellence; (2) best use of available resources; and, (3) transparency and accountability. The organization is being structured to facilitate easy expansion into a national program, and later, possibly into a regional program.

An experienced team of experts and advisers has been identified to manage the operations, oversea the training of local professionals and technicians to continue the program into the future and to assist with the arrangement of financing (See Appendix A). This team includes personnel and consultants with management experience in medical entomology, medical science, aerial ULV spray operations, pesticide application management, and accounting, financial control and data processing.

The success of the program will be assessed internally on a continuous basis and the results will be easily accessible by stakeholders. Critical operational data, entomological, medical and cost accounting, will be collected daily and be part of continuous feedback. The impact of all the operations are assessed so that critical decisions about ongoing operations can be made based on almost real-time feedback.

A critical success factor is associated with active community involvement. The Program will use Mosquito Abatement Districts or similar community based groups throughout Monrovia and other locations where the Program starts operating to engage the local community and to manage the Program, especially data collection and to be the focus of the public information campaigns.

The long term sustainability of the Program depends on cost effectiveness. One part of the strategy for this is a very strong training component so that there is rapid Liberianization of the management and operations with no loss of operational efficiency and management accountability.

Project goals

The major goal is to reduce the incidence of malaria in Monrovia Liberia from the present levels to less than 10% of these levels. There is substantial data about the current incidence of malaria in patients attending clinics or in hospital, and this information will be tracked during Program implementation. The Program will also set up a data system to identify parasite prevalence in the population at large, and monitor changes in this over time.

The reduction in the mosquito population is regarded as an essential component of the Program, and it will be measured very carefully with a comprehensive data collection effort. This is not, however, the ultimate goal of the Program, but an essential step in the successful implementation of the Program.

Financial projections

The financial projections have been prepared using a projection model that reflects the different operational activities. The data to make precise projections are not easily available, if they exist at all.

The current cost projections based on preliminary information that is currently available suggest that the Program cost will be $25 million over five years. The Program has been designed to serve the great Monrovia area over around 50,000 acres, but it appears that the optimum capacity of the Program will enable many other urban areas in Liberia to be treated as well within this cost envelope. Making the most effective use of the resources being deployed under this Program can make a very big difference in the unit cost of operations. For example the cost of ULV aerial spraying is in the range of $1.50 to $2.50 per

acre, a very small cost compared to ground spraying, even with low cost labor, and done in hours rather than days or weeks. In terms of effective intervention, the speed of response is critical and most easily done with aerial applications.

The following table shows the allocation of cost by year and by major expenditure category:

Project Costs for Five Years* In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5Yr total
Equipment, durable assets	2,800	500	400	100	100	3,900
Working capital	500					500
Operating program	3,700	3,500	3,300	3,100	3,000	16,600
Community cooperation	200	200	200	200	200	1,000
Management and admin.	800	700	600	500	400	3,000
TOTAL PROJECT COST	**8,000**	**4,900**	**4,500**	**3,900**	**3,700**	**25,000**

* Preliminary – under review

The projections of costs are derived from an operations cost model that is being development both for Program planning and for ongoing operations management. The numbers are still being refined and the program optimized taking advantage of all existing cost and performance information that is available to us. The following table is an estimate of investment required for for equipment and durable assets:

Equipment, durable assets ** In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5Yr total
Improvements to buildings	500					500
Aircraft, with spray equipment	1,300					1,300
Specialized ground equipment	1,000					1,000
Upgrading equipment		500	400	100	100	1,100
Total	**2,800**	**500**	**400**	**100**	**100**	**3,900**

* * Preliminary – under review. These numbers include delivery costs.

The operating program components are projected to cost :

Operating Program by Component for Five Years*** In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5Yr total
Aerial spray	1,800	1,200	1,000	1,000	1,000	6,000
Ground fogging, area spraying	500	500	500	500	400	2,400
Interior Residual Spraying	700	600	600	600	600	3,100
Medical interventions	700	1,200	1,200	1,000	1,000	5,100
Operating program	**3,700**	**3,500**	**3,300**	**3,100**	**3,000**	**16,600**

*** Preliminary – under review

The financial model referred to above suggests that the Program can be implemented at a cost per capita under $15 for a period of five years, compared to the cost of $25 per capita shown above. No data based on actual experience have been found yet to confirm the lower costs. What the model also suggests is that the cost per unit of benefit depends to a great extent on the effectiveness of the intervention, rather than the amount of resources consumed by the activity.

Mobilization and start up

The cost of mobilization and start up is estimated to be $3 million as set out in the table below:

Mobilization and Start Up *
In thousand dollars ($ 000)

Description	Qtr 1	Qtr 2	Total
Improvements to buildings	80	40	120
Aircraft, with spray equipment	900	450	1,350
Ground spray equipment	110	0	110
Lab equipment and other	110	70	180
Transport	100	0	100
Operating costs	220	220	440
Working capital (inventory)	150	650	800
Operating program	**1,470**	**1,630**	**3,000**

* Preliminary – under review

Financing

The initial five years funding is being sought from a variety of sources. The following table shows a possible mix of funding that would support the Program in this initial period. Multiple sources of funding are desirable:

Financing Plan
In thousand dollars ($ 000)

	Year 1	Year 2	Year 3	Year 4	Year 5	Ongoing/year
Government of Liberia	500	500	500	500	500	500
Private sector in Liberia	0	0	0	100	200	400
Multilateral funding agencies	2,000	1,000	1,000	600	500	200
Bilateral funding agencies	4,000	2,000	1,500	1,100	1,000	200
Private philanthropic funding	1,000	800	800	800	800	800
Corporate support	400	450	500	500	500	700
Small private contributors	100	150	200	200	200	200
TOTAL	**8,000**	**4,900**	**4,500**	**3,900**	**3,700**	**3,000**

In the long run the financing of the Monrovia Mosquito / Malaria Program must be possible by some form of local funding, along the lines of the funding for Mosquito Abatement Districts in many parts of the United States. In order for

local funding to be feasible the whole of the operation must be sustainable with a world class Liberian management and operating team.

Program support, endorsements and policy convergence.

The Monrovia Mosquito / Malaria Control Program has the support and endorsement of key communities and stakeholders including (1) the Government of Liberia, (2) the academic and scientific community in Liberia, (3) the medical professionals in Liberia, and, (4) the Liberian civil society through LIHEDE and some faith based groups. The Program also responds to recently announced policy initiatives in the donor community that put malaria control much more in the forefront of relief and development efforts.

Conclusion

Many organizations have funded malaria control programs over the years. These have usually been programs with a single component, and the results have been limited. The Monrovia Mosquito/Malaria Control Program is multi-dimensional, truly integrated, and based on programs that have been successful in the past in the United States and Australia.

APPENDIX 1

MANAGEMENT AND STAFF BIOGRAPHIES

Biographies of Some Key Staff

The following are some of the people who are committed to the success of this initiative and will form the core of the management team – in alphabetical order.

Peter Burgess
Controller and Management Information Services
Peter Burgess is an expert in financial control and management with experience with international companies and the global relief and development sector. He is the founder and CEO of Tr-Ac-Net Inc, the Transparency and Accountability Network. He has been a pioneer in using available data to improve management informations and decision making. During his corporate career, he was CFO of Continental Seafoods, Inc, a US company that operated a successful fisheries joint venture in Liberia and around the world during the 1970s. He earned a double major in engineering and economics at Cambridge University and trained as a chartered accountant with Coopers and Lybrand in London.

William Nesler
Operations Manager and Senior Pilot
Bill Nesler is commercial aircraft pilot with over 20,000 hours of flying time, of which 15,000 hours have been in agricultural pest control operations. He has been chief pilot in charge of 8 airplanes, 9 pilots, 3 mechanics and numerous ground crews. He has been licensed and has worked in most of the agricultural states in the USA and has lived and worked in Liberia for almost 20 years. He has experience working with Liberians and an understanding and appreciation of the local traditions and customs. While living in Liberia, Mr. Nesler and his family suffered from severe attacks of malaria, giving him a personal understanding of the problem. Mr. Nesler will serve as the Program's operations manager.

Robert J. Novak
Medical Entomologist
Robert Novak will ensure that the Program follows rigorous scientific discipline and help to optimize the activities of the Program to ensure effective operation and good results. He is a professional scientist affiliated with the University of Illinois at Urbana-Champaign with vast experience with vector control both in the United States and in Africa. He earned a Masters degree at the University of Utah and PhD at University of Illinois.

Delvin Walker
General Manager
Delvin Walker will be the overall manager of the project. He was chief of the science department at Cuttington College in Liberia prior to the outbreak of the civil war. He has extensive experience in program management and is a trained entomologist. He has worked with international relief and development assistance organizations in countries around Africa for many years. He received a master's degree from California Polytechnic and has other academic training from other universities.

Jeffrey Widmann
Training Manager and Senior Pilot
Jeffrey Widmann is an experienced aerial applicator and an active and highly regarded flight instructor, with over thirty years experience, he has provided students with the specific training necessary to operate the Grumman Agcat safely. He is a retired U.S. military officer with experience in international flight operations and training and is a Federal Aviation Administration certified aircraft mechanic. Mr. Widmann will assume the position of training manager and chief pilot to train selected Liberian pilots in the field of aerial application of pesticides. Mr. Widmann has lived and worked in Monrovia and is familiar with the customs and culture of the Liberian people. He has flown commercial flight operations in Liberia and has held a Liberian commercial pilot certification and work permits.