W.A.L.R.U.S.

Water and Land Resource Utilization Simulation

PLAYER'S MANUAL

WISCONSIN VERSION

By Charles Thurow, John Steinhart, Tom Smith

Game Originated by Allan G. Feldt,
David Moses and James Eckroad,
The University of Michigan

SEA GRANT ADVISORY REPORT NO. 3

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WATER AND LAND RESOURCE UTILIZATION SIMULATION

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CHARLES THUROW, JOHN STEINHART, TOM SMITH

This is a revised edition of the Player's Manual for WALRUS I originated by Allan G. Feldt with David Moses and James Eckroad at the Environmental Laboratory, School of Natural Resources, the University of Michigan. This manual is designed to be used with the game as it was adapted for the Wisconsin Sea Grant College Program.

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UNIVERSITY OF WISCONSIN

SEA GRANT COLLEGE PROGRAM

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SEA GRANT COMMUNICATIONS OFFICE
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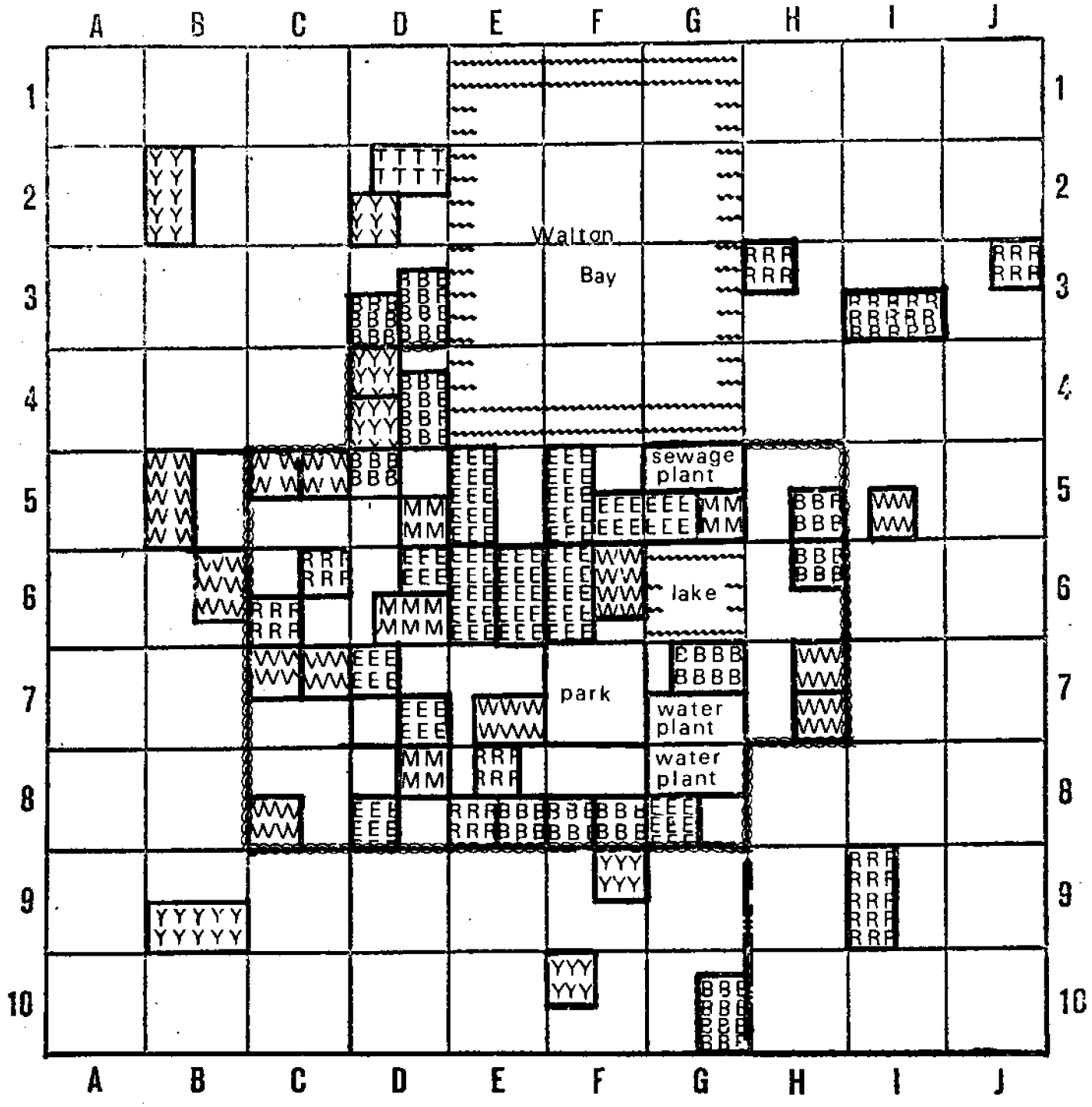
Initial Property Ownership



Legend

EEE Ebony team
WWW White team
YYY Yellow team
BBB Blue team
RRR Red team
MMM Walton
TTTT West Twp.

INTRODUCTION

The Goals

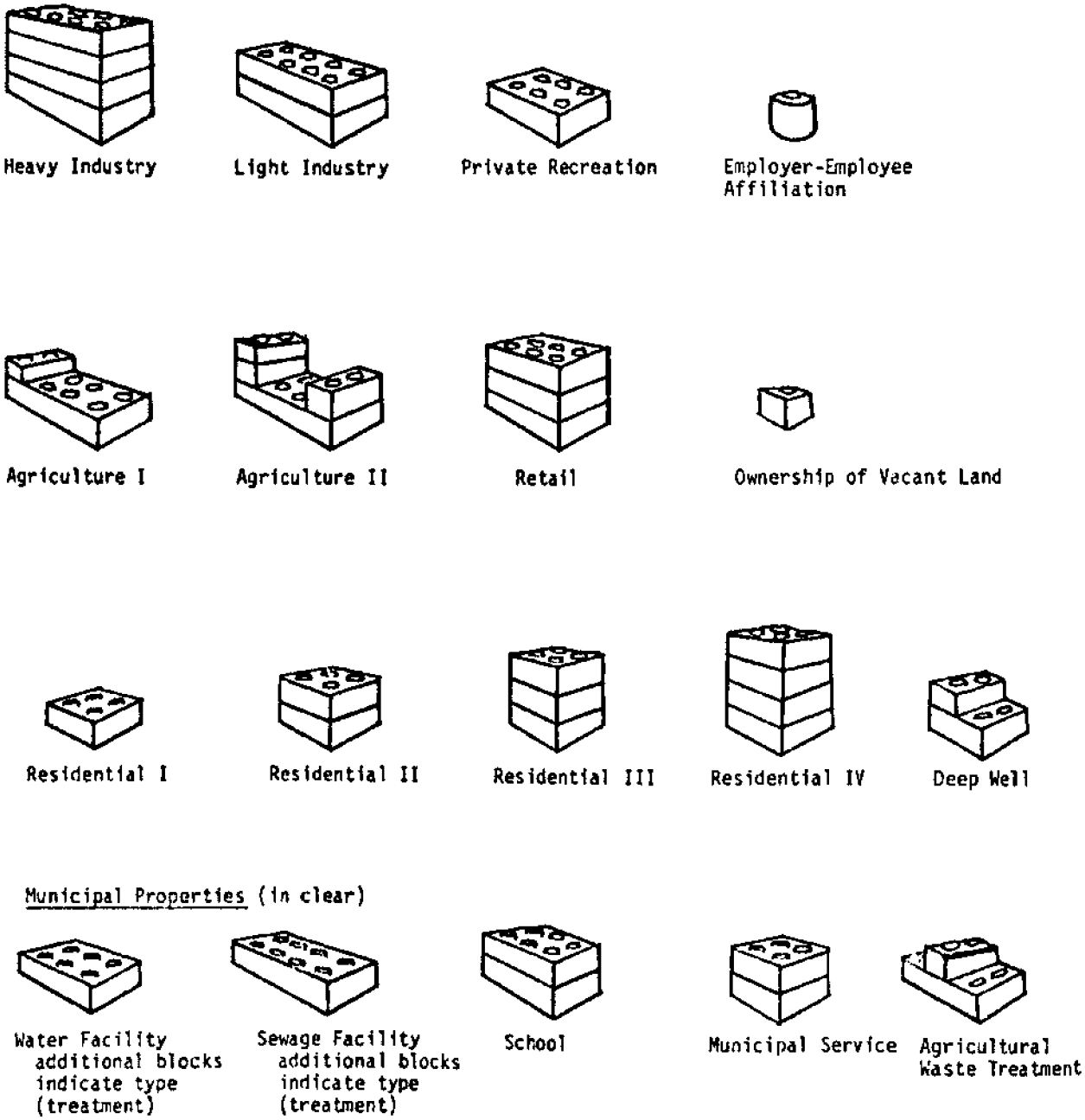
In large part, WALRUS is a game about the processes of establishing goals and the strategies for implementing them in a heterogeneous environment. That environment is the physical and social realities simulated in the game: a medium size town, Walton, situated on a bay and surrounded by two predominately rural townships. The game is played in rounds which represent approximately a year's time.

During play of the game players attempt to control, and possibly optimize, their own position and the status of the region with respect to any one or more of four basic elements: economic strength, political strength, personal status and prestige, and overall environmental quality of the water resources. Each of these dimensions is represented by an element in the game. No single goal is provided for all players to attempt to optimize and any given player may choose as his own criteria for winning the game any one or more of these factors in any personally meaningful combination. Other aspects of the game, aside from those discussed here, may also be selected as goals. Nothing in the nature of the game requires consensus on the goals chosen. Indeed, the lack of consensus among possible goals or the complexity of establishing a consensus is probably one of the more realistic aspects of this simple form of simulation modeling.

The Physical World

The players must deal with two major physical constraints in establishing and implementing their goals. The first is the natural limitations of available land and the inevitable trade-offs in land-use decisions. This constraint is represented by the playing board.

Figure 2. WALRUS Lego Components



WALRUS I is played on a 50-knob by 50-knob Lego board marked off into 4-knob by 4-knob cells, which in turn are separated by single-knob divider strips. Each knob represents approximately 10 acres of land area, the distance between four knobs approximates one-half mile, and each cell approximates one-quarter square mile. Divider strips are used to represent public rights of way between cells and must be the location of any roads, sewer lines, or water lines provided during the game.

The second major constraint from the physical world is water pollution. The pollution feeds back through general aesthetic deterioration of the area, through difficulties providing adequate water supply, and finally through a decrease in income for recreation investment.

Pollutants in the game are measured according to the number of units of effluent which accumulate in the bay and river system according to the land uses in existence and the type of treatment provided for effluents. The operator simply keeps a record of how many effluents are emitted from each land use on the board and notes where it enters a river or the bay. The effluents, measured in units of K, decay slightly over each round but usually build up in the bay at a rate faster than the rate of "natural" decay. The greater the amount of development, the greater the rate of addition of effluents to the aquatic system. The rate and amount of deposition may be decreased by providing sewer lines and sewage treatment facilities in various locations. The effectiveness of such facilities matched against their cost is the basic control over environmental degradation in WALRUS. Such control requires money and carefully developed political cooperation in order to be successfully accomplished.

Social and Economic Environment: The Teams and Governments

The major complexity in the game's environment involves the interaction

of the teams and the governmental units. Players are assigned to private business teams in groups of three to seven per team. Each of the five teams represent a particular set of business and geographic interests and players often play in a manner representing those interests. Such "role-playing" activity is not required, however, and players may make decisions and play the game in any manner they wish within the constraints imposed by the game rules and steps of play. In turn, members from the various teams constitute the public bodies -- the Walton City Council and the two town boards. All the teams have votes on the Walton City Council and each of them appoints a member to represent their interests at the council meetings. This body is the dominant political decision-making body in the game. The town councils, in contrast, are dominated by a single team, though other teams do have some votes on these councils. They too have meetings at which decisions concerning zoning, or sewage treatment, or other public projects are made.

The red and yellow team

Red and yellow teams are primarily agricultural in orientation and are each in political control of one of the suburban townships, East Township and West Township, respectively. They have a limited amount of direct political power within the city itself although their monolithic status in the townships makes them important to city players. The interests and goals of these teams might be similar, although they can readily diverge into two antithetical directions. Limiting growth in the township and seeking to maximize return from agricultural investments is one direction and requires care in matters of zoning and land sales. Conversely, re-zoning agricultural land to residential, commercial, or industrial will encourage growth and development by other teams, escalation of land value, and a rise in property taxes. A significant increase in residential

development by other teams might, of course, result in loss of the political power enjoyed by the red and yellow teams in their townships. Provision of adequate water and sewer services for these developments is a continuous problem and usually gets the developing township into issues of annexation to the city, purchase of services from the city, or independent provision of services by either the township or private investors. Water supply is particularly important to the yellow team since they usually must provide water for the West Township school by the end of the first round. Major alternatives are to require a region-wide water and sewer authority or requiring no services at all for development, thus letting each investor solve his own problems and protect his own interests. At the beginning of the game, both townships have a very low level of taxation and virtually no capital or operating expenses.

The ebony team

The ebony team has primarily industrial holdings within the city. It also represents one of the major voting blocks within the city. As the major employer, the ebony team receives a substantial number of influents and is a crucial supporter for most city programs. Depending upon city government policies the ebony team may follow a policy of industrial expansion either within the city or in the townships or may begin to diversify. The team is certainly not bound to a conservative stand on pollution issues -- any may in fact take the lead in central activities, depending upon expected impact of these policies and ebony's own ideological conception of how to behave.

The blue team

The blue team is engaged in recreational industries such as hotels, campgrounds, marinas, etc. The political strength of the blue team within the city

is equal to that of the ebony team and, like the ebony team, provides a fairly important segment of the employment base of both the city and the townships. The blue team will be one of the first to feel an impact from high levels of water pollution, although this impact may be quickly passed along to other players in terms of reduced employment, loss of shopping, increased welfare, and slower rates of growth. Diversification of commercial holdings owned by the blue team is one form of protection against environmental impacts. The alternative is a vigorous water pollution control policy for the whole area.

The white team

The white team holds a monopoly of retail stores and has an important share of political power in the city. As the only retailer in the city, the white team may, in the short run, reap exorbitant profits from all other players by raising prices to the upper limit allowed. Such an action is almost certain to result in other teams entering retailing as quickly as possible. General growth of the city is in the interests of the white team because of its position in the retailing structure. Some diversification of holdings is also a potentially desirable strategy to avoid overdependence upon the goodwill and tolerance of customers from all other teams. The white team is politically in a swing position in terms of city politics, offering enough votes to make cooperation with any other team very attractive. Tax rates in the city plus a rapid rate of development are immediate concerns, with only secondary and longer term interests in the problems of environmental degradation which worry other teams more directly.

RULES OF PLAY

The game is controlled by two sets of rules, one set called "man-made laws" and one set called "natural laws." The man-made laws exist for each of the three political jurisdictions. Yet another set is used which is not written down but which reflects the general constitutional and legal restraints imposed on all activities by county, state, and federal legislation and precedent. Man-made laws may be changed by majority vote of the governing body of each jurisdiction and more may be added within reasonable limits of existing state and national legislation.

Natural laws are representations of what are seen to be the major environmental and economic constraints affecting behavior and development. The laws are stated in rather crude terms appropriate to the simple game-simulation model. Natural laws may be changed by any player presenting a reasonable argument and/or documentation of another natural law which is more "real" and which is reducible to the simplistic format required for operation of this game.

Man-made laws for each of the three jurisdictions and natural laws for the entire game are given below and on the following pages.

Man-Made Laws

Where there is variance among the three jurisdictions, it has been indicated in the text.

1. Appointments: The executive has the power to appoint employees in municipally owned services and to negotiate wage rates for these employees. The executive also has the power to appoint city officials such as tax collector and planner.
2. Annexation: Annexation of all or any part of a surrounding jurisdiction

requires majority approval of both governing bodies as well as approval of the teams owning the land to be annexed.

3. Condemnation: Condemnation of privately owned land for the public good may be enacted by a two-thirds majority of the appropriate public body with just compensation for private owners directly affected. Compensation is to be between 75% and 125% of the initial construction costs of any building and at the rate of at least $20,000 per cell of land within the city limits and $5,000 in the townships.

4. Federal/State Aid: Decisions to apply for federal or state aid must receive majority approval of the legislative body and application fees must be paid from public funds. Approval of an application constitutes an agreement to encumber the town for the necessary proportional payment of the project immediately upon winning the grant.

> *Federal or state aid for any specified public use may be applied for by any municipality. The cost for an application is $10,000 per application. Such aid will cover 75% of the total cost of any approved public project, exclusive of land acquisition costs. The probability of receiving approval is normally 35% but may be increased or decreased by the payment of influents to the operator. Five influents will increase or decrease the probability by 10%. When an application is submitted in one round, the dice are rolled in the next round and the funds become available immediately if the roll is successful.*
>
> *Loans from the operator may be obtained at 10% interest per round. The maximum available to any team is 25% of the value of its total assets. The rate of repayment is at 10% of the principal plus any accrued interest each round. Loans to municipalities are automatically granted upon the appearance of a deficit in the budget. The rate of interest on municipal loans is 5% and the maximum indebtedness available in any round is equal to the size of the operating budget in the preceding round.*

5. Rights of Way: Sale or lease of a public right of way to a private team or permission to build upon such right of way requires approval of the legislative body. Rights of way bordering two jurisdictions

require approval of both governing bodies.

6. Taxation: Taxes are based on land use. Changes in tax rates or in system of taxation are made by simple majority vote of Town Board. Any changes in the system of taxation must make provision for necessary accounting procedures by the town tax collector. All changes in level or type of taxation must be announced one round prior to taking effect. Taxes are currently at the following rates per round:

Initial Tax Structure

	Walton	East Township	West Township
Residential	$ 1,500	$ 500	$ 500
Heavy Industry	20,000	18,000	12,000
Light Industry	10,000	9,000	6,000
Recreation	7,000	4,000	7,000
Retail	7,000	3,000	3,000
Agriculture I		1,000	1,000
Agriculture II		2,000	2,000

7. Votes: One vote in the legislative body is received for each residential cell in which a team has a majority of the residential units. In the first round the teams have the following votes:

TEAMS	VOTES		
	Walton	E. Twp.	W. Twp.
Round 1			
red	2	4	0
yellow	1	0	5
blue	4	0	1
white	4	1	1
ebony	4	0	0
Total	15	5	7

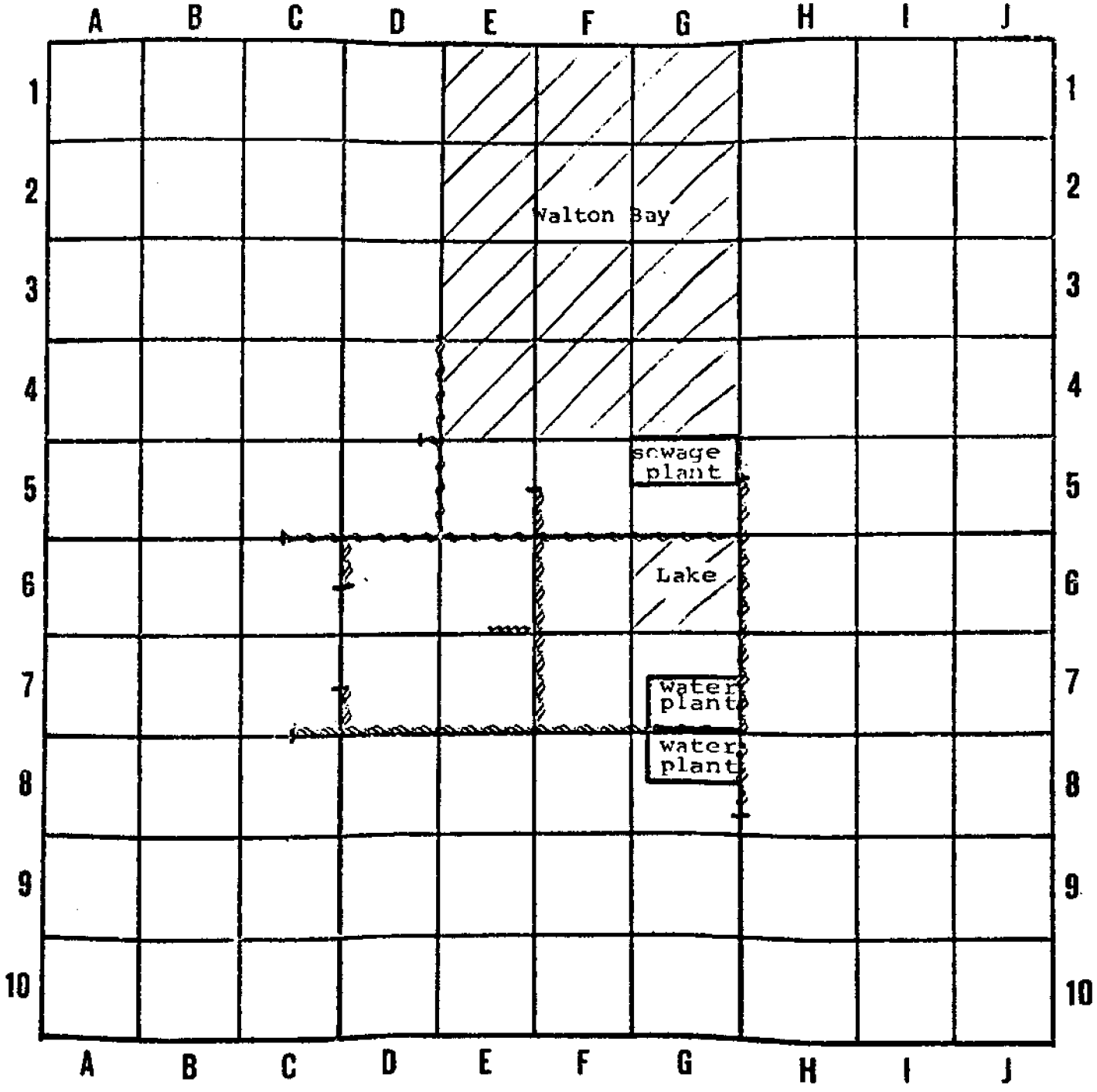
8. Water and Sewer Services: No construction is allowed within the city in any cell which is not serviced with an adequate level of water and sewer services. Provision of these services from existing capacity is the responsibility of Common Council but may be delegated to some other city official. No septic beds are allowed within the city limits. Only publicly treated water supplies may be used within the city limits, i.e., no direct river or groundwater sources may be used. Municipally owned city and water services may not be extended to users outside the city limits without annexation.

   Either water or sewage treatment plants may be built at public or private expense without any legal constraint. Services thus provided may be extended to any user desiring them upon agreement on some mutually satisfactory rate and method of compensation. Services may not be extended within the jurisdiction of another public body without the consent of that body.

9. Welfare: Any residential unit without employment may apply to the tax collector for welfare payments in lieu of income. The current level of payment is $3,000 per round per residential unit.

10. Zoning: The existing zoning map for the city shall be enforced by the mayor or his appointee. Changes in zoning may be enacted by majority vote of Common Council acting upon a petition presented to Council. All changes in zoning must be announced and posted on the zoning map. At present, zoning categories are hierarchial ascending in inclusiveness from agriculture, to residential, to commercial, to light industry, and finally to heavy industry.

Water and Sewer Services



Legend

Water & Sewer lines together

Sewer lines alone

Natural Laws

Land use characteristics

Land uses in WALRUS are restricted to those listed in the basic components section which follows. The basic components section also provides the initial construction cost for each type of use, the number of employees required for operation, the water and sewer requirements, and gross income. For public land uses, capacity and operating costs are also reported. The following additional characteristics for particular land uses also apply:

1. Heavy and light industry and retail stores may only locate in a cell adjacent to a major highway.
2. Recreation industries may only locate on cells adjacent to a major river or the bay. As pollution levels in the adjacent body of water rise, its income is decreased according to the following schedule:

Pollution Reading of River or Bay Cell	Decrease in Basic Income
10K	25%
20K	50%
30K	100%

3. Each residential unit must "consume" one food unit each round by submitting it to the operator at the end of the round. The food unit must be purchased from a retail store.
4. Each retail store may purchase up to twenty food units from the operator each round at a wholesale price determined by the operator. He may sell these to his customers at a price not exceeding 200% of the wholesale price. Unused food units may be carried as inventory from round to round.
5. A school has a maximum capacity of serving 25 residential units. If the total capacity of all schools on the board is exceeded by the total

number of residence on the board, a 10% reduction in all incomes to all land uses will be charged for each 10 excess residential units.

6. A municipal service unit represent standard expenditures for urban services such as fire and police.

Basic Component Characteristics

Land Use Type	Construction Cost	No. of Employees	Water Needs	Effluent	Capacity/ Gross Income/ Service Area	Operating Cost/Round (excl. wages)
Heavy Industry	$100,000*	4 R Units	4K	8K	60,000	0
Light Industry	50,000	2	2	2	27,000	0
Recreation Ind.	25,000	2	3	3	25,000 max.	0
Retail Store	25,000	1	2	2	(Price x Cust.)	0
Agriculture I	25,000 (plus land)	1 (self)	1	1 + 1/4 farm cell	10,000/9 cells (± 10% for ≥ 9)	0
Agriculture II	50,000* (plus land)	2 (self + 1)	3	3 + 1/2 farm cell	25,000/9 cells (± 10% for ≥ 9)	0
R1 Residence	10,000	---	1	1	4-8,000	0
R2 Residence	25,000*	---	2	2	Twice R1	0
R3 Residence	40,000*	---	3 x R1	3 x R1	3 x R1	0
R4 Residence	60,000*	---	4 x R1	4 x R1	4 X R1	0
Rn Residence	n x 15,000*	---	n x R1	n x R1	n x R1	0
Public Park	10,000/cell	1	1	1	---	2,000
Public School	40,000	2	2	2	25 R Units	8,000
Deep Well System	10,000	0	0	0	5K	3,000
Water Plant II**	25,000*	1	0	0	20K	5,000
Water Plant III	50,000*	1	0	0	50K	15,000
Septic Bed I	5,000	0	0	0	1K	0
Agr. Waste Treat. Sys	10,000	0	0	0	3K	0
Sewage Plant II***	20,000	1	0	0	15K	5,000
Sewage Plant III	40,000*	1	0	0	40K	10,000
Sewage Plant IV	75,000*	1	0	0	100K	20,000
Major Highway	50,000/knob	0	0	0	0	0

*Cost given is for new construction only. If the land use is upgraded from a lower intensity use, only the difference in construction cost need be paid.
**The capacity of a water or sewer plant can be increased up to four times by the payment of an additional 10% of the initial construction cost for each 5% increase in capacity.
*** The efficiency of a sewage plant is normally 80%. It may be increased once by an additional 10% by increasing operating costs by 25%.

Water and sewer characteristics

The quantity and quality of both water and sewage are measured by an index called K. This index is used to describe the capacity of water and sewer plants, the pollution level of a river or bay cell, the amount of water required by a particular land use or a given cell, and the amount of sewage generated by a particular land use or cell. The capacity of water (small clear Lego block) or sewer (small black Lego block) is shown along public rights of way as 1K capacity per small block. Initially there is some unused capacity shown by the stacks of blocks on top of water and sewer plants.

1. Groundwater is available to each cell at the rate of 1K per cell. Such water is available for use in its own cell or in any adjacent cell at the rate of 1K per round and is not subject to pollution. Land in agricultural use is assumed to use the groundwater for either the farm site or for the cell itself. If the groundwater is used to supply the needs of another land use, it cannot be used for agriculture. Groundwater cannot be used for industrial purposes.
2. Water from a bay or river cell may be used directly without appreciable treatment cost as long as the pollution level is below 5K per cell in the cell from which the water is drawn. Water at greater than 5K level of pollution may not be used without passing through a treatment plant.
3. The installed capacity of water and sewer services to any cell is measured by the number of knobs (1K per knob) of clear or ebony Lego placed on any adjacent public right of way, not counting corners. The same installed capacity may be counted towards cells on either side of the right of way.
4. The efficiency of a sewage treatment plant is normally 80%, e.g., for 100K of sewage treated, 20K of pollutants are discharged into the bay or a river. Efficiency may be raised once by an additional 10% by increasing

the operating costs of the plant by 25%.

5. The capacity of a water or sewer plant may be increased up to four times by the payment of an additional 10% of the initial construction cost for each 5% increase in capacity.
6. The Agricultural Waste Treatment System is a system to handle agricultural wastes. It can be placed on the cell containing the farm buildings or any other cell of farm land. If it is placed on farm land, that cell cannot be counted in calculating gross income. The system has a 3K capacity and can only serve adjacent cells.

Influents and votes

Voting power of each team in any jurisdiction is based upon the distribution of its residential units in that jurisdiction: one vote for each square in which the team has the majority of the residences. Additional votes may be purchased at 5 influents per vote, for each ballot.

1. Influents are earned by a team as follows:
   a. One influent for each employee from another team.
   b. One influent for each residential unit living in a cell bordering on a major river or bay at a pollution level below 5K.
   c. One influent for each public office held in any municipality. No more than three such offices may be established in any municipality.
2. Influents may be expended as follows:
   a. Five influents may purchase one additional vote on any issue through payment to the operator.
   b. Five influents may purchase one line of "newspaper space."
   c. Five influents may be paid to the operator to purchase a 10% increase or decrease in the probability of receiving federal or state aid.

STEPS OF PLAY

WALRUS is played in rounds. The rounds have two functions: first, they simulate time periods of approximately a year, and second, they allow the game's feedback from water quality. At the end of each round the effects of land-use decisions on water quality are calculated and fed back into the game. The rounds also give the players an opportunity to reassess their goals and strategies.

Team Action

Each round consists of a number of activities: financial transactions, governmental functioning, and individual team decisions and actions. Since these activities go on simultaneously, it is necessary to divide the tasks among various team members. These tasks may overlap and team members may want to be involved in a number of activities, but it is good to set prime responsibility with specific individuals. The following is one possible model for this division:

Group Decisions:

A. Assess team's land holdings, income, and influence.

B. Decide goals and strategies.

C. Divide up various tasks.

Task 1: Collect Income

(a) Collect income from the bank for industries.

(b) Collect wages for residences employed by other teams.

Task 2: Payments

(a) Pay food costs for residences.

(b) Pay wages for employees from other teams.

(c) Pay taxes.

Task 3: City Council Representative

(a) Attend meetings.

(b) Keep team informed about actions taken.

(c) Introduce agenda items of team interest.

Task 4: Township Representatives

(a) Attend meetings.

(b) Keep team informed about actions taken.

(c) Introduce agenda items of team interest.

Task 5: Private Sector Decisions

(a) Buy or sell land.

(b) Construct new buildings.

(c) Make or change shopping and employment commitments.

Governmental Action

The three governmental units essentially organize themselves. The Walton City Council's first meeting is announced and run by the operators in order to facilitate the election of the mayor, but from that point on the members decide procedures. As the elected official, the mayor has three responsibilities:

1. appoint a tax collector and one other official that he deems necessary,
2. collect agenda items and set agenda for meetings, and
3. call meetings and preside over them.

The township governments operate by the same basic pattern except that the players themselves decide when these governments become operating parts of the game.

Ends of Rounds

The end of a round of play is a time for general announcements and discussion of the game. The end of each round will include:

1. announcements of public actions and programs,
2. announcement of the pollution results from the last period of play, and
3. questions about the game's components and rules.

The final round includes a much more detailed discussion at its end. At this time the various team explain their strategies and evaluate why they were or were not effective.

Accounting Forms

Each team is provided with a set of two accounting forms. Each of these forms provide the same basic information in two different formats.

The team-property-holdings account lists all of the property holdings of each team giving its location, and appropriate information on its operating income and costs. These indicate gross income, payments for wages and salaries to employees, taxes, other payments such as for retail goods, and the net profit or loss on the property in question. At the beginning of the game, players should look over the listing provided for their team and familiarize themselves with their holdings and their commitments to other teams and governments. Keeping these accounts up-to-date during successive rounds is the responsibility of each team and care should be taken to enter all new construction and any changes in commitments which occur during each round.

The second form is called the cash flow sheet. It provides a record of transactions by team and jurisdiction. This account should show the same amounts and commitments as those entered on the property holding account, except for income from the outside world. This form is the most important for keeping track of

immediate financial transactions among teams; therefore, it is important to keep it updated as well as the property holding account.

Another set of forms is provided for each of the three municipalities. The first is a basic balance sheet of its gross income and expenditures. The second is like the team cash flow sheet in that it shows what is paid to each individual team, and the final one is a tax sheet showing the taxes on various land uses and how much is collected from each team.

Finally, a set of pollution records are maintained by the operator or his assistant. These are open to inspection by any interested players at any time.